



**U.S. DEPARTMENT OF COMMERCE**  
**National Oceanic and Atmospheric Administration**  
**NATIONAL MARINE FISHERIES SERVICE**  
Pacific Islands Fisheries Science Center  
2570 Dole St. • Honolulu, Hawaii 96822-2396  
(808) 983-5300 • Fax: (808) 983-2902

## **CRUISE REPORT<sup>1</sup>**

**VESSEL:** *Oscar Elton Sette*, Cruise SE-10-02 (SE-78)

**CRUISE PERIOD:** 11 February – 14 March 2010

**AREA OF OPERATION:** Guam and Commonwealth of the Northern Mariana Islands (CNMI: Rota, Farallon de Medinilla and Saipan)

**TYPE OF OPERATION:** Personnel from the NOAA National Marine Fisheries Service (NMFS), Pacific Island Fisheries Science Center (PIFSC) Coral Reef Ecosystem Division (CRED) and Fisheries Monitoring and Socioeconomics Division (FMSD) and Northwest Fisheries Science Center (NWFSC) Fishery Resource Analysis and Monitoring Division (FRAM), the University of Western Australia, the University of Guam (UoG) and the Woods Hole Oceanographic Institution (WHOI) conducted marine resource surveys in waters surrounding Guam and the Commonwealth of the Northern Mariana Islands.

**ITINERARY:**

6-10 February Mobilized equipment for cruise including installing an over-the-side pole equipped with multibeam echosounder and transducers for autonomous underwater vehicle (AUV) navigation and communications.

11 February In port inner Apra Harbor (V-pier), Guam. Embarked scientists Scott Ferguson, Jacob Asher, John Rooney, Joyce Miller, Frances Lichowski, Jonathan Weiss, Mary Donovan, LT Tony Perry III, Steve Lindfield, Mark Priest, Vivienne Blyth-Skyrme, Elizabeth Clarke, Jeremy Taylor, Jeff Anderson, Erica Fruh, Curt Whitmire, Christopher Murphy, Eric Cruz, Linda Tatreau and Réka Domokos. Departed at 1130. Exited Apra Harbor and collected 120 kHz EK60 data to serve as a template for subsequent data processing. Returned to Apra Harbor and disembarked Réka Domokos by small boat. Conducted a conductivity-temperature-depth (CTD) cast and performed a patch test to calibrate the pole-mounted multibeam. Departed Apra Harbor for Galvez Bank.

---

<sup>1</sup>PIFSC Cruise Report CR-10-002  
Issued 23 April 2010



- 12 February Began multibeam survey of the northern portion of Galvez Bank, conducting CTD casts as required.
- 13 February Continued multibeam survey of Galvez Bank. Conducted baited camera station deployments with 1 BotCam and 4 Baited Remote Underwater Video Stations (BRUVS) stations. Resumed multibeam survey.
- 14 February Continued multibeam survey of Galvez Bank. Conducted AUV deployment. Deployed AUV from the starboard quarter; AUV was fouled in the guy wires supporting the over-the-side pole and damaged. Recovered AUV and began repairs. Deployed towed camera (TOAD) to conduct video transect of bank top. Resumed multibeam survey.
- 15 February Continued multibeam survey of Galvez Bank. Deployed AUV from the fantail between the A-frame. The deployment was successful until, as the mission began, a tag line became fouled as the AUV was being released. Recovered the AUV from the stern, damaging its strobe light. Made repairs and redeployed the AUV without incident, and ran its planned mission for 1 ½ hours until its safety drop weight was released prematurely and it returned to the surface. The AUV was recovered without incident using the crane at the longline pit. Resumed multibeam survey.
- 16 February Continued multibeam survey. Conducted EK60 survey. Conducted baited camera station deployments, completing 4 BotCam and 15 BRUVS deployments and recoveries. Conducted EK60 survey. Conducted AUV operations. The AUV was deployed and ran its planned mission for over 3 hours until it released its safety drop weight prematurely at midnight and returned to the surface.
- 17 February Continued AUV operations, recovered the AUV. Conducted EK60 survey. Conducted baited camera station deployments, completing 4 BotCam and 16 BRUVS deployments and recoveries. Conducted EK60 survey. Conducted AUV operations. Upon activation, the AUV rebooted its internal computer and the mission was terminated. The AUV was recovered and an investigation began to determine the reason for the problem. Conducted multibeam survey of the South Galvez Bank.
- 18 February Continued multibeam survey of South Galvez Bank. Returned to Galvez Bank and conducted baited camera station deployments, completing 4 BotCam and 16 BRUVS deployments and recoveries. Conducted AUV operations. AUV was deployed and successfully completed a 3 ¼ hour mission before being recovered.
- 19 February Conducted EK60 survey. Conducted baited camera station deployments, completing 4 BotCam and 16 BRUVS deployments and recoveries.

- Conducted EK60 survey. Conducted AUV operations. AUV was deployed and ran a 2-hour mission before being recovered.
- 20 February Conducted EK60 survey. Arrived at Guam offshore near Agana Harbor. Disembarked Eric Cruz by small boat transfer. Returned to Galvez Bank and conducted baited camera stations deployments completing 5 BRUVS deployments and recoveries. Conducted AUV operations. The AUV was deployed and ran its planned mission for 2 ½ hours. Conducted a multibeam survey of 11-Mile Bank north of Galvez Bank. Departed for Rota.
- 21 February Arrived at Rota. Disembarked Elizabeth Clarke and embarked Andrew Halford by small boat transfer. Deployed 19-ft SAFE Boat off west coast of Rota with Perry, Lindfield and Priest to deploy and recover BRUVS in nearshore areas, completing 8 BRUVS deployments and recoveries. Conducted multibeam survey to fill gaps in existing data. Conducted AUV operations. The AUV was deployed and ran a planned 4-hour mission.
- 22 February Continued AUV operations. AUV completed its mission and was recovered. Deployed 19-ft SAFE Boat off southeastern coast of Rota at 0800 with Perry, Lindfield and Priest to deploy and recover BRUVS in nearshore areas, completing 13 BRUVS deployments and recoveries. Conducted multibeam surveys near BRUVS deployment site. Conducted AUV operations. The AUV was deployed and ran a planned 4-hour mission.
- 23 February Continued AUV operations. The AUV completed its mission and was recovered, but only one photograph was taken during the AUV mission. Deployed 19-ft SAFE Boat off southeastern coast of Rota at 0800 with Asher, Lindfield and Priest to deploy and recover BRUVS in nearshore areas, completing 16 BRUVS deployments and recoveries. Conducted multibeam surveys to fill gaps east and north of Rota. Conducted AUV operations. The AUV was deployed and ran a planned 3-hour mission.
- 24 February Continued AUV operations. The AUV completed its mission. This mission included the first compressed photographs that were transmitted from AUV to the ship by using an acoustic modem. Disembarked Joyce Miller and Jeremy Taylor by small boat transfer to Rota. Deployed 19-ft SAFE Boat off southeastern coast of Rota with Asher, Lindfield and Priest to deploy and recover BRUVS in nearshore areas, completing 14 BRUVS deployments and recoveries. Embarked USGC representatives to participate in interagency activities with *Sette*. Conducted multibeam surveys to fill gaps east and north of Rota. Departed Rota.
- 25 February Arrived Saipan at 0830. In port.
- 26 February Disembarked Donovan, Perry, Priest, Halford, Anderson, Fruh, Whitmire and Murphy. Embarked Michael Akridge.

28 February	Departed Saipan at 1500 en route to Farallon de Medinilla (FDM).
1 - 5 March	En route to Farallon de Medinilla. Began multibeam survey of banks surrounding FDM; conducted CTD casts as required.
6 March	Completed multibeam survey of the banks surrounding FDM. Conducted reconnaissance survey of a charted 47-fathom sounding located 12 nautical miles (nmi) NNE of FDM, but no bottom was detected at depths less than 400 meters. Began survey of 37-fathom bank 17 nmi NNW of FDM, conducted CTD casts as required.
7 March	Completed survey of 37-fathom bank. Began survey of 35-fathom bank 26 nmi of FDM, conducted CTD casts as required.
8 March	Multibeam surveys were halted when the POS/MV position orientation system failed, preventing the multibeam soundings from being correctly georegistered. The survey of the 35-fathom bank was almost completed prior to this failure, leaving only a small portion of the northern edge of the bank unsurveyed. Numerous attempts were made to repair the POS/MV without success. Conducted towed camera (TOAD) video transect of 35-fathom bank.
9 March	Departed 35-fathom bank en route to Saipan. Conducted safety drills.
10 March	Arrived at Saipan anchorage area. Conducted baited camera station deployments, completing 8 BRUVS deployments and recoveries. Deployed a High-frequency Acoustic Recording Package (HARP) at 15° 18.998'N 145° 27.542'E.
11 March	Conducted baited camera station deployments, completing 24 BRUVS deployments and recoveries. Conducted towed camera (TOAD) operations.
12 March	Disembarked USCG personnel by small boat transfer. Conducted baited camera station deployments, completing 24 BRUVS deployments and recoveries. Conducted towed camera (TOAD) operations.
13 March	Continued to conduct towed camera (TOAD) operations. Conducted baited camera station deployments, completing 16 BRUVS deployments and recoveries. Departed for Apra Harbor, Guam
14 March	Arrived at Apra Harbor, Guam. Demobilized survey equipment and disembarked Scott Ferguson, John Rooney, Frances Lichowski, Jonathan Weiss, Steve Lindfield, Viv Blyth-Skyrme, Linda Tatreau and Michael Akridge.

**Table 1.--Cruise statistics for SE-10-02.**

	<b>Galvez Bank (north)</b>	<b>Galvez Bank (south)</b>	<b>Eleven-Mile Bank</b>	<b>Rota</b>	<b>Farallon de Medinilla</b>	<b>Banks north of FDM</b>	<b>Saipan Anchorage</b>	<b>CRUISE TOTALS</b>
Multibeam surveys, sq. km.	<b>33.3</b>	<b>5.9</b>	<b>1.4</b>	<b>22.6</b>	<b>146.0</b>	<b>103.0</b>	<b>0</b>	<b>312.2</b>
Shalllow water CTD casts	<b>9</b>	<b>1</b>	<b>1</b>	<b>4</b>	<b>12</b>	<b>3</b>	<b>0</b>	<b>27</b>
EK60 surveys, km	<b>60.3</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>60.3</b>
BotCam deployments	<b>17</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>17</b>
BRUV deployments	<b>72</b>	<b>0</b>	<b>0</b>	<b>51</b>	<b>0</b>	<b>0</b>	<b>72</b>	<b>123</b>
AUV transects, km.	<b>8.1</b>	<b>0</b>	<b>0</b>	<b>10.0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>18.1</b>
TOAD transects, km	<b>4.8</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>12.7</b>	<b>8.4</b>	<b>25.9</b>

Note: the aerial coverage of the multibeam survey for Rota and Farallon de Medinilla does not include areas surveyed prior to this cruise.

## **MISSIONS:**

- A. Conduct benthic habitat mapping of important fishery resources in the vicinity of Guam and the CNMI. Multibeam mapping surveys will be conducted to depths of 250 m or greater. Bathymetry and acoustic imagery from these surveys will be augmented with optical data collected with towed camera and/or AUV to characterize these benthic habitats.
- B. Gather quantitative information about deeper reef fish assemblages at banks near Guam, Rota and Saipan.
- C. Assess feasibility of non-extractive sampling gear (AUV, towed camera sled, baited camera stations and fisheries echosounders) to characterize fishery resources through comparisons with data collected using traditional extractive gear (fishing gear).
- D. Support NOAA's Teacher-at-Sea program to give teachers a clearer insight into our ocean planet, a greater understanding of maritime work and studies, and to increase their level of environmental literacy by fostering an interdisciplinary research experience.

## **RESULTS:**

See Appendices.

## **SCIENTIFIC PERSONNEL:**

Scott Ferguson, Chief Scientist, Pacific Islands Fisheries Science Center (PIFSC), National Marine Fisheries Service, (NMFS), Coral Reef Ecosystems Division (CRED)  
John Rooney, Science Coordinator, Joint Institute for Marine and Atmospheric Research (JIMAR), University of Hawaii (UH), PIFSC, CRED  
Jacob Asher, CRED Scientific Liaison to CNMI and Guam, JIMAR, UH, PIFSC, CRED  
Joyce Miller, JIMAR, UH, PIFSC, CRED  
Frances Lichowski, JIMAR, UH, PIFSC, CRED  
Jonathan Weiss, JIMAR, UH, PIFSC, CRED  
Mary Donovan, JIMAR, UH, PIFSC, CRED  
LT Tony Perry III, PIFSC, CRED  
Steve Lindfield, University of Western Australia  
Mark Priest, University of Guam  
Vivienne Blyth-Skyrme, JIMAR, UH, PIFSC, CRED  
Elizabeth Clarke, Northwest Fisheries Science Center, (NWFSC) Fishery Resource Analysis and Monitoring Division (FRAM)  
Jeremy Taylor, JIMAR, UH, PIFSC, CRED  
Jeff Anderson, JIMAR, UH, PIFSC, CRED  
Erica Fruh, NWFSC, FRAM  
Curt Whitmire, NWFSC, FRAM  
Christopher Murphy, Wood Hole Oceanographic Institution  
Eric Cruz, JIMAR, UH, PIFSC, Fisheries Monitoring and Socioeconomics Division

Linda Tatreau, Guam Department of Education  
Réka Domokos, PIFSC-Ecosystems and Oceanography Division  
Andrew Halford, University of Guam  
Michael Akridge, JIMAR, UH, PIFSC, CRED

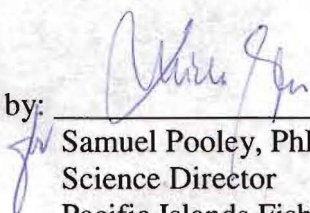
**DATA COLLECTED:**

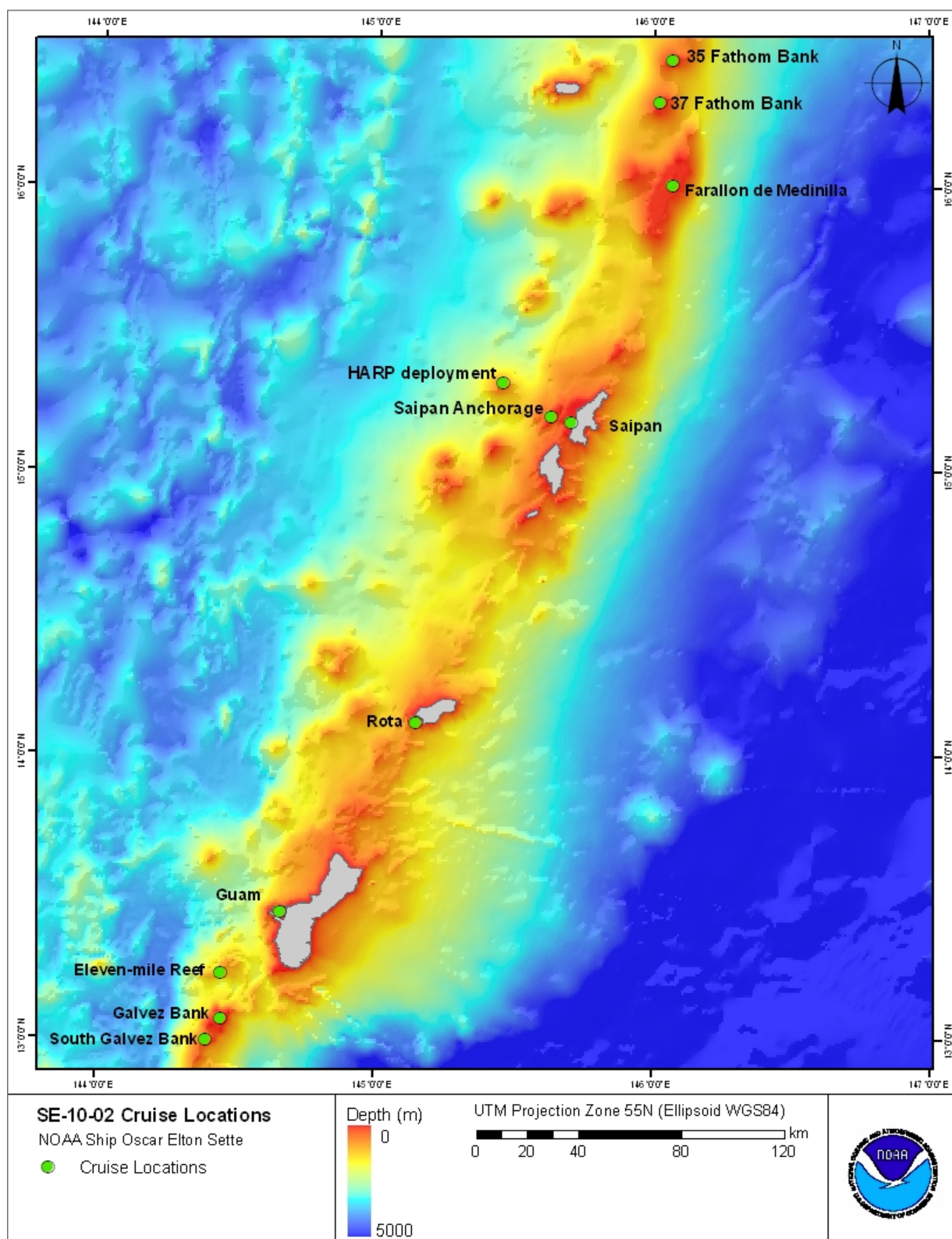
Multibeam bathymetry and backscatter imagery  
EK60 fisheries echosounder data  
Still camera photos (downward and forward looking) from AUV  
Video data (forward looking) from AUV  
Conductivity, Temperature, Depth (CTD) data from AUV  
Video data from BotCam  
Temperature and salinity data from BotCam  
Video data from BRUVS  
Still photos (downward looking) and video data (downward and forward looking) from TOAD  
Acoustic Doppler Current Profile (ADCP) data  
CTD casts to 170 m

Submitted by: \_\_\_\_\_

  
Scott Ferguson  
Chief Scientist

Approved by: \_\_\_\_\_

  
Samuel Pooley, PhD  
Science Director  
Pacific Islands Fisheries Science Center



**Figure 1.--Locations occupied by NOAA ship *Oscar Elton Sette* during cruise SE-10-02, February 11 –March 14, 2010.**



## Appendix A: Methods

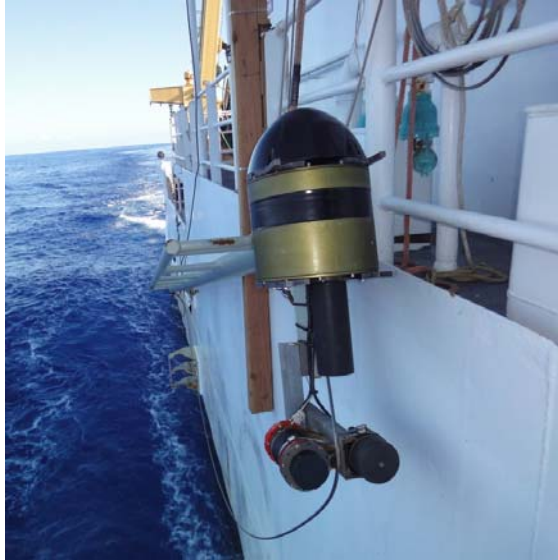
### A.1. Multibeam Mapping

(Joyce Miller, Frances Lichowski, Jonathan Weiss, Viv Blyth Skyrme, John Rooney, Michael Akridge, Scott Ferguson; Survey Tech: Mike Keeler, Linda Tatreau)

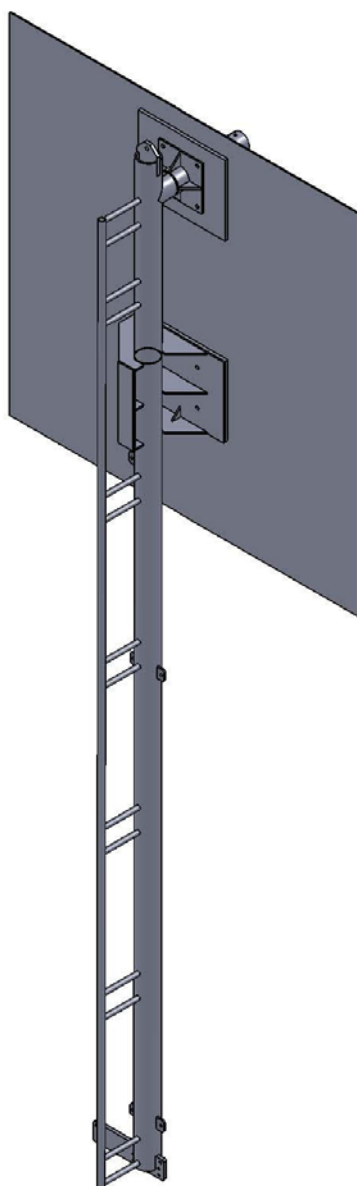
#### A.1.1. System Installation and Description

Multibeam mapping for cruise SE-10-02 was conducted with a Reson 8101ER multibeam sonar aboard the NOAA Ship *Oscar Elton Sette*. The Reson 8101ER is a 240-kHz sonar with  $101 \times 1 \frac{1}{2} \times 1 \frac{1}{2}$  [degree](#) beams. The vessel was also equipped with an Applanix Position Orientation Sensor for Marine Vessels (POS/MV) vertical reference system, which provides timing, position, velocity, pitch, roll, heave, and heading information for correction of motion in the multibeam data. A Sea-Bird Electronics (SBE) SBE 19 conductivity-temperature-depth (CTD) sensor was used to provide sound velocity profiles (SVPs) that are critical for proper correction of sound velocity errors associated with multibeam data.

The multibeam sonar was installed aboard the *Sette* using a 0.125-m diameter, 8-m long pole on the starboard side of the ship (Fig. A.1.1.2). The pole was installed during the pre-cruise Guam in-port period, and the Reson 8101ER transducer was mounted so that it was 0.5 m below the ship's keel when the pole was in the vertical deployment position. Transducers for navigation of the autonomous underwater vehicle (AUV) were also installed on the same pole. When transiting, the pole was lifted out of the water to the side of the ship and secured (Fig. A.1.1.1). The POS/MV inertial measurement unit (IMU) was installed at the ship's centerline on the mast in the ship's dry laboratory and the Global Positioning System (GPS) antennae were installed on the top of the winch house. All offsets between the multibeam transducer, the POS/MV IMU, and the two GPS antennae were measured as accurately as possible and entered into the POS/MV software. The reference position was defined as the center of the pole at its pivot point, and Table A.1.1.1 documents the measured offsets from that location (x is positive forward, y is positive to starboard, and z is positive downward.)



**Figure A.1.1.1--RESON 8101ER multibeam transducer mounted on over-the-side pole. Transducers for AUV navigation and communication are mounted aft of (below in this photo) the multibeam transducer.**



**Figure A.1.1.2--Drawing of over-the-side pole installed on the *Sette*.**

**Table A.1.1.1.--Multibeam Transducer, IMU, and Antennae Offsets Entered into POV-MV.**

Location	x (m)	y (m)	z (m)	
Reference Point	0	0	0	Center of pole at the pivot point
Top of IMU	9.07	-7.493	-2.98	
Starboard Antenna	2.18	-5.29	-8.52	
Port Antenna	2.49	-9.131	-8.52	
Transducer	-0.13	0.047	7.32	
Vessel's center of rotation	19.9	-7.493	-1.90	
Distance between antennae		3.85		Distance mostly in y direction

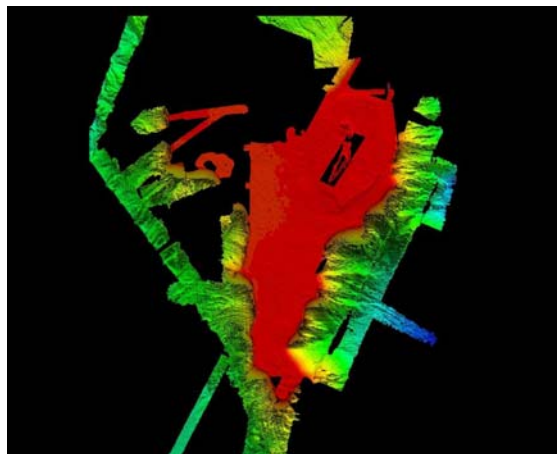
A distance from the waterline to the pole's pivot point (2.3 m) was taken at the beginning of the cruise on 9 February, and the transducer depth was determined to be 5.02 m below the waterline. At that time, the ship's draft measurements were 15.3 ft (bow), 15.0 ft (port) and 14.4 ft (starboard aft). After the cruise was finished on March 14, the distance from the waterline to the pole's pivot point was observed to be 2.5 m. At that time, the ship's draft measurements were 14.0 ft (bow), 15.0 ft (port) and 14.5 ft (starboard).

Roll and pitch bias calibrations were conducted in Apra Harbor, Guam, and later on Galvez Bank in calm conditions. Roll and pitch bias values were set to zero before execution of the patch test. These biases were determined to be +0.13 roll and -0.34 pitch. The roll bias was entered into the real-time ISS-2000 software before the Galvez Bank surveys on 11 February 2010, and the pitch bias was entered into the real-time system on 18 February 2010, after the Galvez Bank surveys were completed. The pitch bias value was applied to the GSF files for 11-18 February 2010, in postprocessing. The roll alignment was checked again during the survey of a 35-fathom Bank; no residual misalignment was observed.

### **A.1.2. Multibeam Data Acquisition and Processing**

#### *Methods for Acquisition and Post Processing*

Prior to the cruise, preexisting multibeam bathymetric data were assembled to prevent resurveying of previously mapped portions of the seafloor. These data included: (1) grids of multibeam bathymetric data from previous CRED cruises to the Mariana Archipelago in 2003 and 2007, (2) data from an ongoing Mariana multibeam synthesis collected by other NOAA and University groups through 2009, (3) multibeam data collected by the Naval Oceanographic Office (NAVOCEANO) during sonar trials on TAGS-60 class oceanographic vessels in 2007-2009, and, (4) near Farrallon de Medinilla, LIDAR (Light Detection And Ranging) bathymetry collected by NAVOCEANO. In addition to the multibeam data, predicted tides for station 1630000 Guam and tide zones corrections (provided by NOAA Center for Operational Oceanographic Products and Services) were integrated into the ISS-2000 software before the cruise. The real-time application of predicted tides was not functioning during for the Galvez Bank survey and tide correctors were applied to data from 11 to 18 February 2010, in postprocessing.



**Figure A.1.1.3:--Coverage plot of multibeam and lidar data provided by NAVOCEANO prior to the beginning of SE-10-02.**

All sensors were interfaced to the SAIC ISS-2000 data acquisition and survey control system, which provided survey planning and data acquisition capabilities. The ISS-2000 survey system enabled seamless sharing of data from previous cruises and other vessels (e.g., R/V *AHI* and NOAA Ship *Hi'ialakai* and NAVOCEANO vessels). The Generic Sensor Format (GSF), which is implemented in the ISS-2000 system, allowed logging of multibeam data from a variety of multibeam sonars into a single, standardized format; the GSF also provided integrated metadata within the real-time multibeam files. In addition, the ISS-2000 created digital message logs that allowed full traceability of software and real-time events. A real-time coverage display, which was part of the ISS-2000 survey system, was installed on the *Sette* bridge to facilitate communication between the mapping and bridge watch standers.

During system configuration, all sonar offsets were entered into either the POS/MV, the sonar acquisition computer, or ISS-2000. Survey plans consisting of coverage grids with preexisting data, coverage grids generated in real time during acquisition, survey plans, track lines, tide zones, etc., were loaded into ISS-2000 prior to data acquisition.

CTD casts were collected at the beginning of each 12-hour period of surveying and reduced to sound velocity profiles (SVP). Standardized survey procedures, including a 2-minute warm-up on deck and a 2-minute surface equilibration, were used on every cast. After the CTD cast was done, the data were downloaded with SeaBird SeaTerm (v. 1.57) software and converted into a sound velocity profile using SeaBird Data Conversion (v. 5.37m) software. The profiles were then loaded using the ISS-2000 and applied in real-time to the data. The multibeam data were carefully monitored for sound velocity artifacts using the real-time displays, and additional CTD casts were performed whenever possible and if necessary. Predicted tide files were prepared before the cruise and were applied to the multibeam data in either real time or postprocessing. The SE-10-02 data set was logged on the real-time computer, and the data were manually copied to back up hard drives on a daily basis. Backups to magnetic tape were performed at the end of the cruise for archiving purposes.

The temporary multibeam system installation worked well during the cruise; however, the POS/MV, a critical component of the system, failed on March 8 bringing the mapping operations to a close. In addition to this failure, there was a noticeable artifact in the bathymetry data. The nature of the artifact suggested that it is either related to flexing of the pole mount or to incorrect calculation of vessel heave as observed at the sonar transducer. The artifact manifested itself as an along-track undulation with an amplitude of ~ 0.1-0.2 m and a wavelength of ~ 15-20 m (Fig. B.1.2). Although the artifact is noticeable when looking closely at the data, the larger scale structure of the sea floor is still clearly represented and remains perfectly useful for the purpose of habitat mapping.

Because the nature of the artifact suggested it might be due to heave, we began to log delayed heave data produced by the POS-MV sensor in real time beginning on JD 44 at 14:21 GMT. A correction derived from the delayed heave data was applied to a subset of the multibeam data. Incorporating this more accurate heave data made little apparent difference in the resulting data. The correction was not applied to the Galvez Bank data set because we did not begin logging the information until halfway through the survey.

The SABER data processing package, which provides full multibeam processing capability, was used to manually edit the multibeam data on a GSF file by file basis, to plot tracklines, to post-apply SVP and tide data when necessary, and to create gridded data sets in the Pure File Magic (PFM) format. PFM is a data storage and display format developed by NAVOCEANO and licensed to SAIC for use in SABER. PFM creation is an area-based editing approach that facilitates the removal of outliers where files overlap. PFM layers were created with previously acquired new data, and edits made to a PFM were unloaded to the GSF files on a daily basis. Backup tarfiles of the raw and processed multibeam data and associated files were created on a daily basis and stored on non-primary data servers and external hard drives. Finalized gridded data sets that combine all of the CRED data from the area will be prepared and distributed by using the PIBHMC Web site at [www.soest.hawaii.edu/pibhmc](http://www.soest.hawaii.edu/pibhmc). These data will be converted to ASCII files for conversion to Arc raster grids and added to the Geographic Information Systems product archive.

Multibeam backscatter extracted from the GSF data were processed in near-real-time using the Hawaii Mapping Research Group (HMRG) software ([www.soest.hawaii.edu/hmrg](http://www.soest.hawaii.edu/hmrg)) to facilitate site selection for BRUVS, BotCAM, and SeaBED AUV operations. GSF data were converted to HMRG backscatter format and then split into 5-minute segments so they could be viewed in the HMRG display programs. Destriping, demicrostriping, and angle-varying gain (AVG) corrections were applied to the backscatter data before they were gridded at a 1-m resolution and mosaicked. Resulting GeoTIFF's were imported into ArcGIS for subsequent analysis.

## **A.2. EK60 Fisheries Acoustics**

*(Eric Cruz, Survey Tech Mike Keeler)*

Two computers equipped with Simrad ER60, and Movies+ software were used to collect acoustic data. The Simrad ER60 software was used to collect the actual raw data from the four EK60 transducers. Each transducer emits a different frequency, 38 kHz, 70 kHz, 120 kHz, and 200 kHz. The lower the frequency, the deeper the sound is able to travel. The Movies+ program receives the raw data, in real time, from the ER60 and converts them to .hac files. It is also used to record time, GPS position, and any significant event during the transect, such as start and stop, turns, or the presence of fish schools. These \*.hac files can also be used to estimate the composition of the plankton layers.

Before collecting acoustic data, each of the four transducers were set to Active mode with a pulse duration of 1.024 milliseconds. In addition, the computers' disk space were checked and their clocks were synchronized to UTC time, and GPS position and velocity were recorded.

Transect lines were created based on the areas where the BotCams and BRUVS were to be deployed for that day. As the ship lined up for the start of the transect, we ensured that the Movies + and ER60 computers were communicating with each other. Once the transect started, recording on the ER60, and archiving on the Movies+ computers were started. Events such as start and stop times, turns, and the presence of fish schools were noted in Movies +. During the data collection process, the ER60 was checked occasionally for the existence of noise due to the ship's speed or weather conditions. If such noise was observed, the ship was slowed or the transect was adjusted so the ship traveled down seas. The ship usually surveyed

at a speed of 5 kts but, if necessary, the speed was reduced to ~ 3.5 - 4 kts. During these surveys, the seas were from the east, so west-bound transect lines have less noise compared to the east-bound transects. At the end of each transect, the recording and archiving of the ER60 and Movies+, respectively, were stopped. If another transect was soon to follow, the recording and archiving were immediately restarted.

During down times, Echoview, another computer program, was used to preprocess the data collected from previous days. This involved taking the raw data from the ER60, filtering out any excess noise, marking the seafloor bottom, and marking any fish school present.

### **A.3 Underwater Vehicles**

Two underwater vehicles were used during the cruise, both of which were used to image the seafloor with still and video cameras and thus provide information about the characteristics of the benthos and the fish and other creatures that utilize that habitat. The vehicles included a SeaBED an AUV, which was deployed from the ship to collect data along preselected transects before being recovered, and a towed underwater camera sled, or towed optical assessment device (TOAD), which was tethered to the ship by a cable. The AUV is designed to automatically maintain a preset distance off the seabed while the TOAD moves over the seabed under the control of a shipboard operator who maintains the camera sled's height off the seafloor by a remotely controlled winch.

#### **A.3.1. Seabed AUV**

*(Elizabeth Clarke, Erica Fruh Curt Whitmire, Jeremy Taylor, Jeff Anderson, John Rooney)*



**Figure A.3.1.1. SeaBED AUV**

The SeaBED-class AUV is unlike other, more traditional AUVs, in that its twin-hull design provides greatly enhanced stability for low-speed photographic surveys. Built by Woods Hole Oceanographic Institution (WHOI), SeaBED is designed to autonomously follow the terrain approximately 3-4 m above the seafloor, collecting high resolution color imagery while maintaining a forward speed of 0.25 to 0.5 m/sec (0.5 to 1 kt). SeaBED is approximately 2 meters long and weighs almost 200 kilograms. It has 2 main pressure housings, a top hull and a bottom hull. The CPU electronics are located in the top hull, and the batteries, cameras, and sensors are located in the bottom hull, and all are connected by wet cabling that is routed through vertical struts. With a maximum depth range of 2000 m, and maximum single-dive time of 6 to 8 hours, SeaBED can be used to survey habitats ranging from shallow coral reefs to deep groundfish environments.

The SeaBED AUV carries two 5-megapixel, 12-bit dynamic range Prosilica GigE strobe-lighted cameras, one downward looking and one forward looking ( $\sim 35^\circ$ ). Imagery from the downward-looking camera is analyzed to ground truth and optically characterize the benthic habitats and communities while the forward-looking camera imagery provides a slight side view to aid fish species identification providing a fishery-independent stock assessment for fish species. Combined, these two imagery data sets can reveal information about fish communities and the benthic habitats and organisms around which they associate. An onboard Seabird model 49 FastCat CTD also recorded temperature and salinity data along the AUV track.

For the missions conducted on Galvez Bank, the AUV was programmed to travel a predetermined route while maintaining an elevation of 3 m above the seafloor at a speed of .25 m/s and taking photographs every 5 seconds. The orientation of the parallel transects was selected to travel over or as near as many baited camera stations as practical while maximizing the AUV's potential for operational success by avoiding navigational obstacles such as steep cliffs. AUV dives on 15 and 16 February as well as 19 and 20 February were conducted over the same programmed track during daylight and nighttime hours to collect data for comparative analysis of different fish assemblages.

For the first AUV mission conducted on the north coast of Rota, the AUV was programmed to travel the same style route of six 400-m parallel transects separated by 140 m (Fig. B.3.1) maintaining an elevation of 3 m above the seafloor at a speed of .25 m/s and taking photographs every 5 seconds. The objectives for the next 2 AUV dives were adjusted to include: (1) engineering trials of new technology to transmit thumbnail photographic images from the AUV to the surface during its mission by acoustic MODEM, (2) exercise the AUV's terrain-following capabilities, and (3) determine the upper operational speed limit of the AUV. To conduct these trials, the programmed mission was a 4 leg ad hoc 3400-km route down-slope from  $\sim 100$  m to 340 m, avoiding especially steep rock outcrops along the way (Fig. C.3.1) AUV dives on 22 and 23 February followed this same route with the only difference being the speed on 23 February was increased to .32 m/s from the more typical .25 m/s.

Once submerged, the AUV does not resurface until the end of its mission. An RD Instruments 1200 kHz Doppler Velocity Log, iXSea Octans Inertial Navigation Unit, and Paroscientific Depth Sensor provide the data necessary for the vehicle's autonomous navigation. Postprocessing the data results in an estimation of the actual georeferenced route traversed by the AUV. Differences in the planned vs. actual routes can result from: (1) errors inherent to GPS resulting in slight inaccuracies in release point position and (2) amount of current drift as the AUV descends before it acquires bottom lock, enabling it to define its navigational origin.

### **A.3.2. Towed Underwater Camera**

*(John Rooney, Vivienne Blyth Skyrme)*

Prior to this cruise, the Towed Optical Assessment Device (TOAD) sled, designed and built by Deep Ocean Ocean Engineering and named the Towed Aquatic Resources Assessment System (TARAS) was refurbished, and several components were upgraded. The TOAD frame is equipped with the following:



- Two Deep Sea Power & Light (DSP&L) Multi SeaCam 2060 low-light color video cameras (one forward-facing for obstacle avoidance and mobile fauna analysis, one downward-facing for benthic fauna and substrate analysis);
- One downward-facing Ocean Imaging System 12000 digital stills camera (consisting of a Nikon D90 digital SLR camera within an aluminum housing);
- Two forward-facing 100 watt DSP&L Multi SeaLites and 50 watt LED Lites;
- One downward-pointing DSP&L SeaArc2 400w HMI light;
- DSP&L SeaLaser 100 pair of parallel lasers for scaling;
- Tritech PA200 Altimeter to detect the height of the camera sled above the seafloor;
- Pressure transducer and fluxgate compass, installed inside an electronics bottle.

The TOAD camera sled was connected to a control console, by using 350 m of 1.92 cm diameter umbilical cable, and deployed by a custom-built winch from a 56 cm diameter sheave on the ship's starboard J-frame. Once in the water, the altitude of the TOAD sled was controlled by winch operation, with the aim of maintaining the sled at an altitude of approximately 2 m above the seafloor. The tow was conducted by allowing the ship to drift, making light turns on the port screw where necessary to adjust the direction of drift.



**Figure A.3.2.1.--TOAD camera sled and remote-controlled winch.**

The console included two monitors displaying live video feed from the forward and downward-facing video cameras that were used by the winch operator to monitor the sled's position relative to the seafloor, as well as allowing real-time scientific observations to be recorded. During deployment, continuous navigation information was fed from a POS-MV into a laptop running Hypack Max hydrographic survey software. Depth information from the sled's pressure transducer was fed into the same software by the TOAD umbilical, as well as the length of cable-out, measured using a wireless cable counter. The approximate position of the TOAD camera sled was automatically determined in Hypack in real-time with a layback calculation using TOAD depth, ship's position and cable-out. Video footage was recorded directly onto mini-DV and backed up on to DVD. Still images were backed up on to external hard-drives.

Starting coordinates for tows were selected in ArcGIS, and were chosen according to the likely drift of the ship.

Data giving the position and depth of the camera sled were subsequently exported from Hypack and then imported into ArcGIS to display the track of the TOAD camera sled over the seafloor. Time stamps on this navigation data were related to the time stamps of the still photographs, allowing the location of the photographs to be determined.

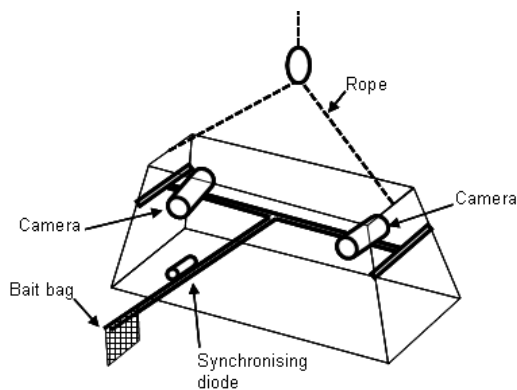
#### A.4 Baited Camera Stations

(Steve Lindfield, Mary Donovan, Mark Priest, Jacob Asher, Tony Perry)

##### A.4.1. Baited Remote Underwater Video Stations (BRUVS)

Baited Remote Underwater Video Stations (BRUVS) are a method for sampling fish communities across a broad range of depths and habitats. Each BRUVS system consists of two high-definition SONY handy-cams mounted 0.7 m apart on a base bar which is inwardly converged at 8 degrees to gain an optimized field of view with visibility of 10 m distance (Fig. A.4.1a). The use of two cameras allows stereo measurement software to calculate and standardize the field of view and provide accurate measures of fish length, while the use of bait attracts a wide diversity of fish species into the field of view of the cameras.

Stereo-BRUVS are termed ‘remote’ because the systems are freestanding on the seafloor without the need for an operator. Each stereo-BRUVS is baited with 1 kg of oily fish (Pacific saury, *Cololabis saira*) which is placed in a closed plastic-coated wire basket and suspended 1.2 m in front of the two cameras. They are deployed by literally dropping them from the vessel at predefined GPS locations with a rope and floats attached. These systems are left to film on the seafloor for no less than 60 minutes, after which the vessel can retrieve them by grappling surface floats and hauling lines with a winch.



A)



B)

**Figure A.4.1a--A) Stereo-baited remote underwater stereo-video system (Stereo-BRUVS). B) Frame grab from video footage collected (right camera). Note synchronising diode and bait bag in view.**

Prior to sampling, multibeam bathymetry maps are examined in ArcGIS to select randomized sampling points in areas of high complexity reef within depths of 30-100 m. Adjacent stereo BRUVS deployments are separated by at least 250 m. This distance was chosen to reduce the likelihood of fish moving between sites within the sampling period. This distance is based on the estimated swimming speeds of common reef fish species and the distance they may travel

over a sampling period. Using multiple systems can make sampling extremely efficient. In this case, 8 systems were deployed and retrieved twice a day (a total of 16 drops).

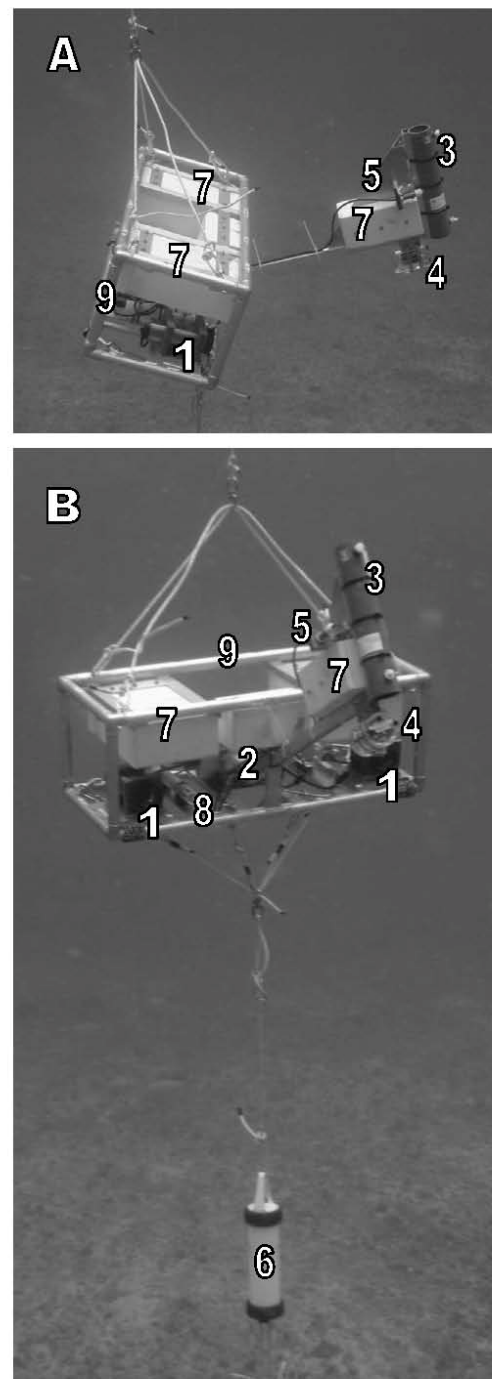
Video footage can be reviewed as soon as the camera is retrieved to the vessel. Video footage is stored on flash memory cards, and these cards are stored and later downloaded and backed up on hard drives in the evenings. Specialized software has been developed to analyze BRUVS video (EventMeasure) and measure fish size (PhotoMeasure) (www.seagis.com).

#### A.4.2. BotCam System

BotCam is designed as a fully autonomous stereo-video camera system. The components are housed in an aluminum frame 1.2 m wide, 0.5 m deep, and 0.45 m tall and designed to protect the camera and maintain fixed camera positions for accurate length measurements (Fig. A.4.2a).

The system is moored to the bottom by weights attached to an anchor line. BotCam floats above the bottom and records video from cameras pointing horizontally down-current with a downward angle of 10 to 20 degrees. This orientation improves the view of the benthic habitat without sacrificing the field of view. The BotCam system is set to begin recording after its release from the boat but prior to its arrival on the bottom.

For each deployment, the recording duration was between 45 and 60 minutes. The frozen bait consisted of the ground bait fish used in the BRUVS and the volume used for each deployment was standardized to approximately 1 liter. The bait was placed in a simple plastic mesh container that allowed the bait to begin thawing and, therefore, dissipate as soon as the system was placed in the water. The bait station was considered to have started when BotCam arrived at the seafloor, as determined from the video. From that point, the cameras were allowed to



**Figure A.4.2a--BotCam side view (A) and front view (B). Ultralow-light video camera (1), controller/power supply/video capture device (2), bait container (3), stereo-video synchronization device (4), bait release system (5), acoustic release (6), Syntactic foam floatation (7), pressure and temperature sensor (8), aluminum frame (9). Not shown below the acoustic release is the anchor.**

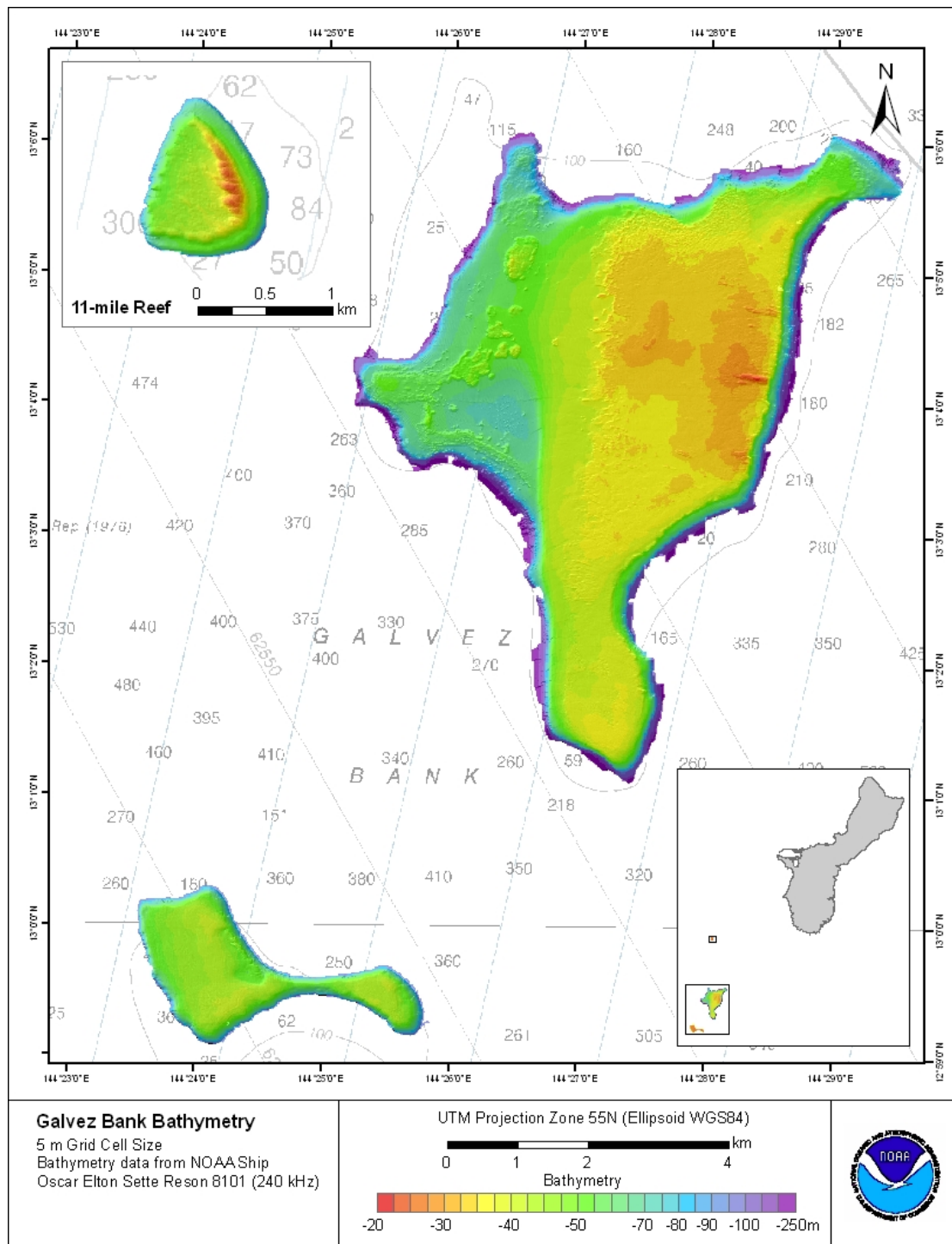
record for a minimum of 60 minutes before BotCam was recovered. The entire system is recovered by line haul, including the anchor. BotCam is designed to have minimal impact to the benthos; it is attached to a steel anchor by a line and sits between 1 and 3 meters above the bottom. The area of the anchor is about 1 square foot. Additionally, the system is weighted in such a way that drag is minimized.

Video is stored on a hard drive located within an electronics bottle protected by the frame. Video is downloaded at the end of the day and is ready for viewing at that time. Video will be analyzed in a similar manner to BRUVS video in the lab.

Site selection was based on initial multibeam data, and was aimed at hard bottom between 30 and 100 m. Sites were selected to be 250 m apart. Once the sites were chosen and the approximate depths were known, surface lines were arranged in buckets on the aft deck in the order they were to be deployed. The lengths of the surface lines were predetermined based on the anticipated deployment depth. BotCam was deployed by using the aft crane; the surface line/buoys were deployed first and were left trailing off the stern while BotCam was staged with the crane and a quick release. The bridge notified the botswain when the ship's transom was 1 minute away from the site; at that time BotCam was lowered to just above the surface/surf line. Then, the bridge announced over the radio when it was time to drop, and the unit was released. For retrieval, the ship came around to bring the surface buoys along the port side where the crew waited in the long line pit with a grappling hook. The units were then brought up from the bottom with the pot-hauler.

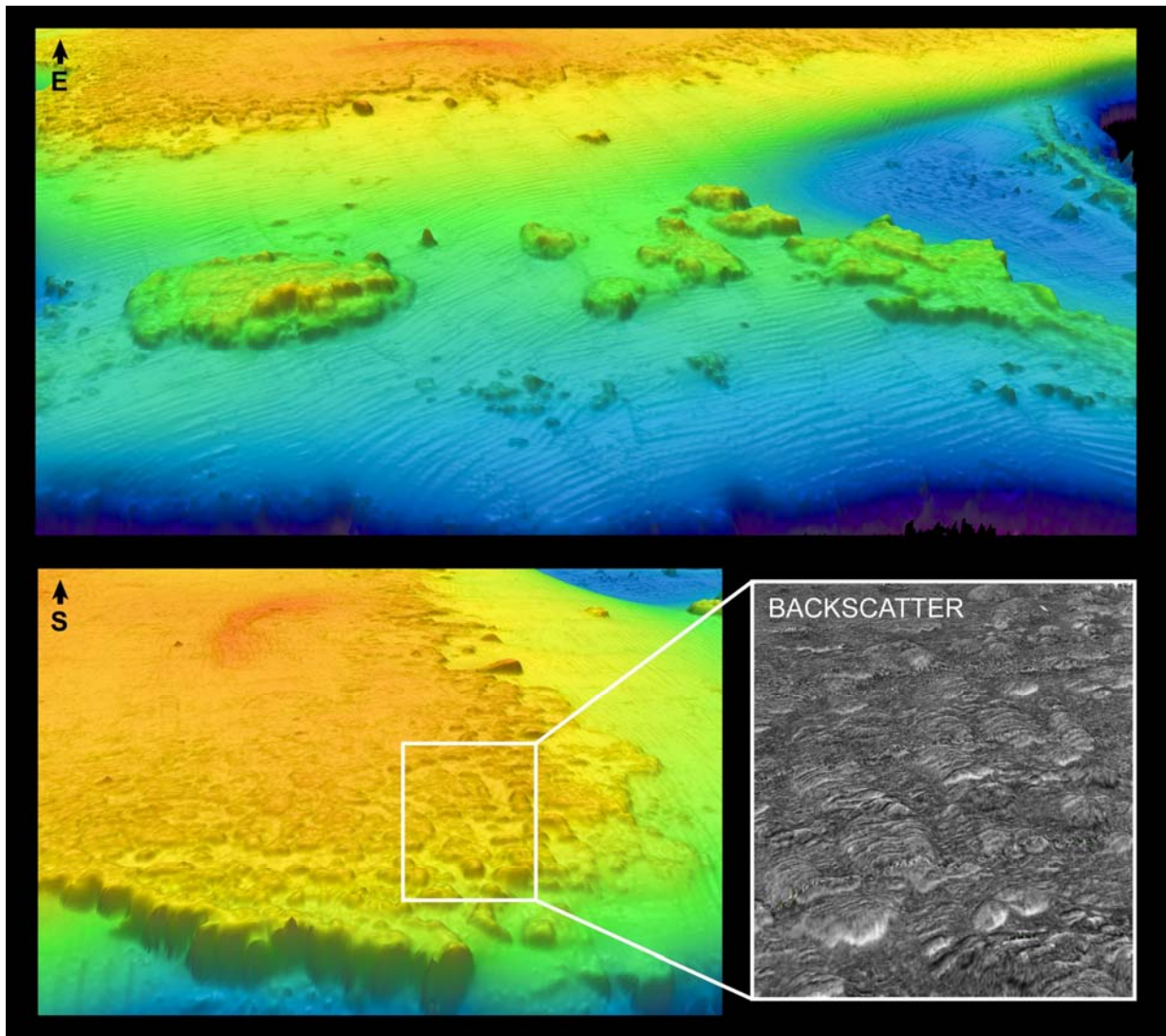
## Appendix B: Galvez and Eleven-mile Bank Results

### B.1. Multibeam Mapping



**Figure B.1.1.--Multibeam bathymetry collected at the northern and southern Galvez Banks and at Eleven-Mile Bank.**





**Figure B.1.2.--Three-D perspective views of high-resolution bathymetry at the northern Galvez Bank, showing the reef structure in comparison to nearby sandy or smooth carbonate areas. The upper figure views the Bank from the western edge looking east and some alongtrack multibeam artifacts can clearly be seen in the smooth sandy areas. The lower figure views the Bank from the north looking south and shows how acoustic backscatter information can be used to provide additional information about the structure of the seabed.**

**Table B.1.1:--CTD casts taken to develop sound velocity profiles for multibeam survey.**

<b>Date time</b>	<b>Cast name</b>	<b>Cast #</b>	<b>Position</b>	<b>Cast depth</b>	<b>Comments</b>
042 2316	ctd10042_01	2	13 02.67N 144 15.85E	130	file name in header is se1002_ctd01; cast 1 not downloaded
043 0841	ctd10043_01	3	13 04.47 144 24.686	140	file name in header is se1002_ctd02
043 1828	se1002_ctd03	4	13 04.427 144 25.224	148	
044 0703	se1002_ctd10044_01	5	13 04.734 144 25.221	148	In header: 13 03.33976 N 144 5.23965
044 1930	se1002_ctd10044_02	7	13 02.993 144 25.506	132	Cast 6 not downloaded
045 0628	se1002_ctd10045_01	8	12 59.771 144 21.944	142	
045 0950	se1002_ctd10045_02	10	13 02.777 144 25.863	126	Cast 9 not downloaded
045 1850	se1002_ctd10045_03	11	13 01.525 144 26.264	131	
046 0555	se1002_ctd10046_01	12	13 03.493 144 27.219	159	
048 1332	se1002_ctd10048_01	13	13 00.4 144 23.34	163	
051 0940	se1002_ctd10051_01	14	13 13.49 144 26.83	160	11-Mile Bank

## B.2. EK60 Fisheries Echosounder Transects

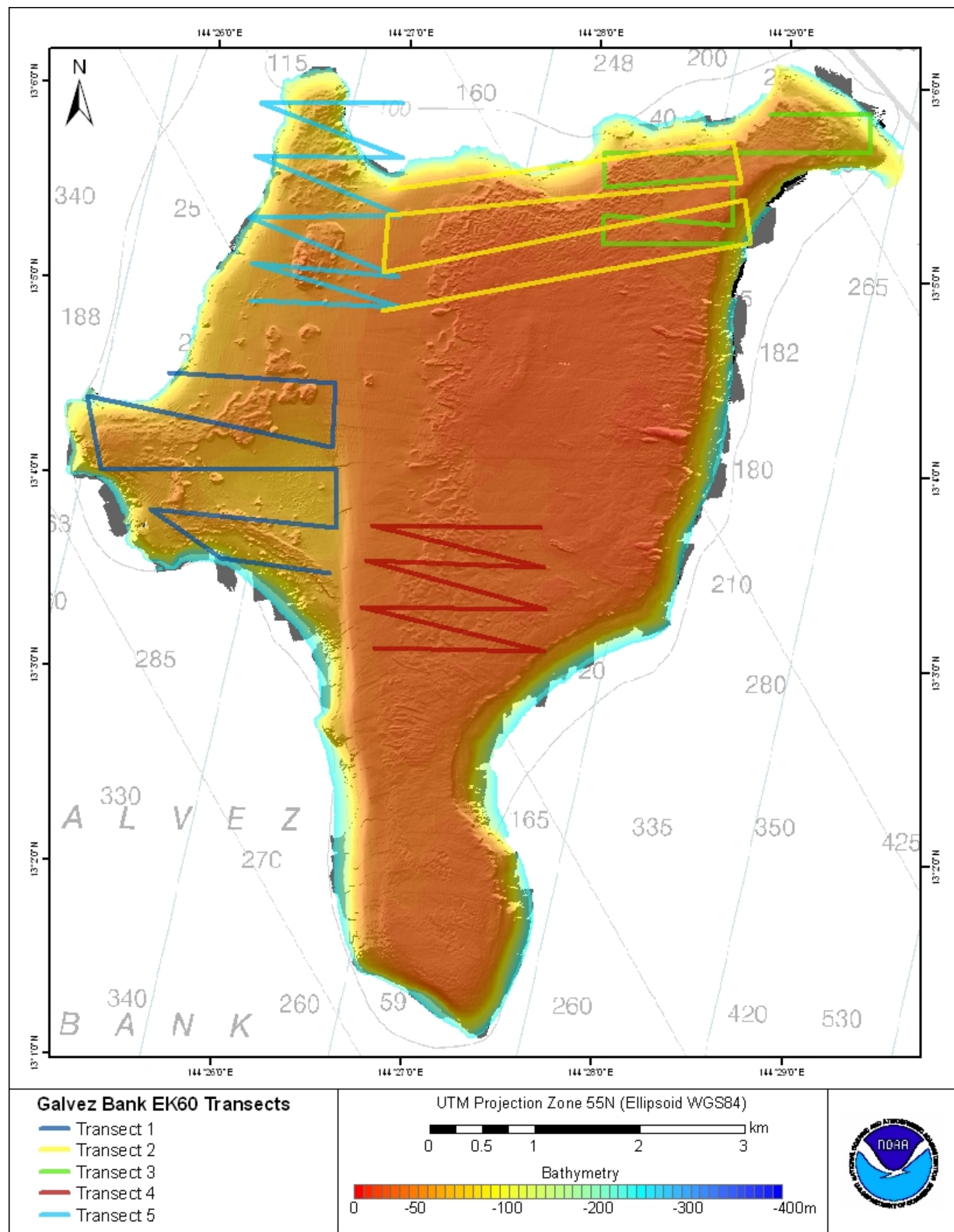


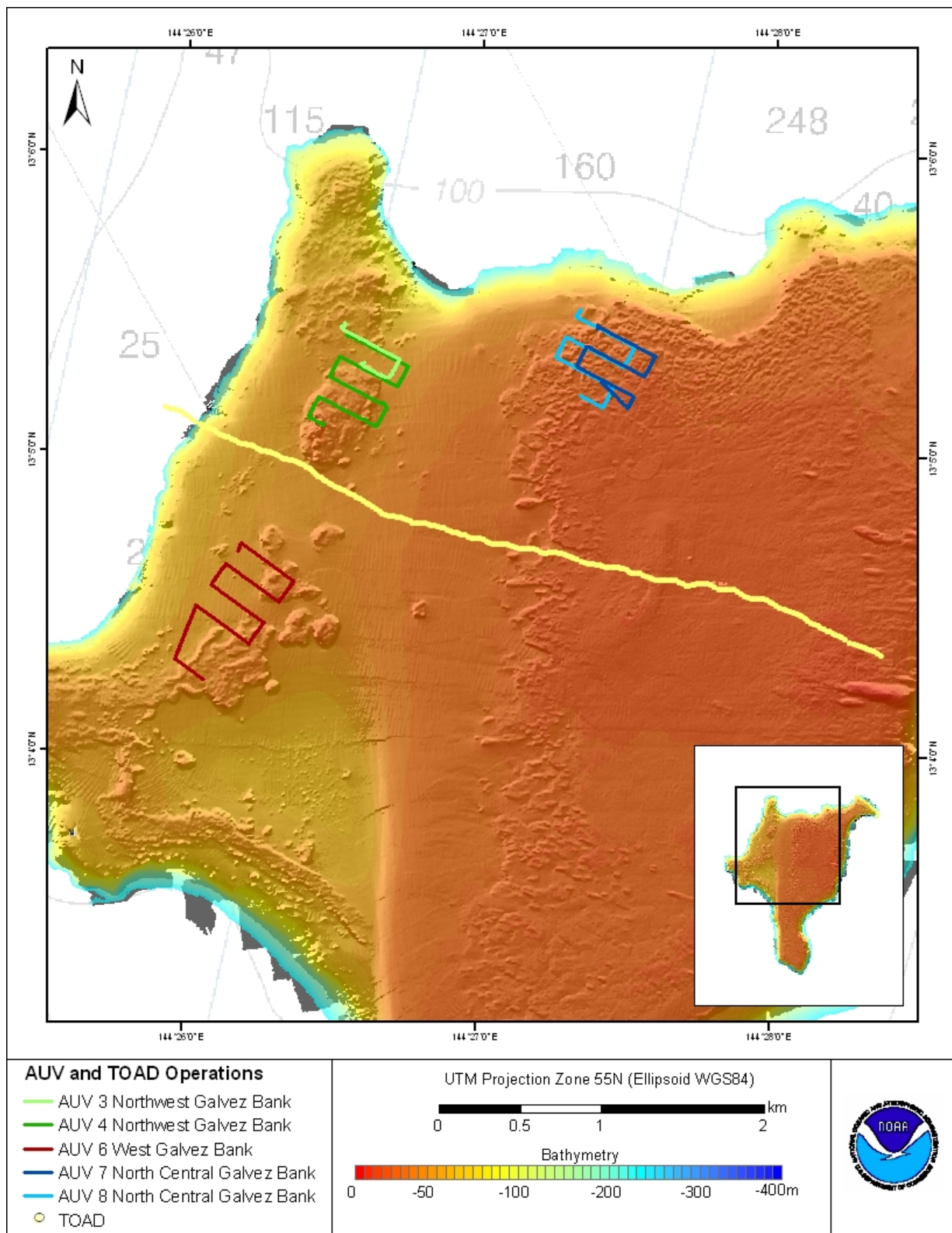
Figure B.2.1.--Location of EK60 fisheries echosounder transects at Galvez Bank.



**Table B.2.1--EK60 fisheries acoustic survey transects at Galvez Bank.**

<b>EK60 transect #</b>	<b>Beginning Time, CHST (+ 10)</b>	<b>Location</b>
1a	Feb 16 0152 – 0650	West Galvez Bank
1b	Feb 16 1750 – 1925	West Galvez Bank
2a	Feb 17 0132 – 0650	North and northeast Galvez Bank
2b	Feb 17 1650 – 2020	North and northeast Galvez Bank
3	Feb 18 1615 – 2025	Northeast Galvez Bank
4a	Feb 19 0200 – 0725	Central Galvez Bank
4b	Feb 19 1700 – 1900	Central Galvez Bank
5	Feb 20 0010 - 0300	Northwest Galvez Bank

### B.3. Underwater Vehicle Transects



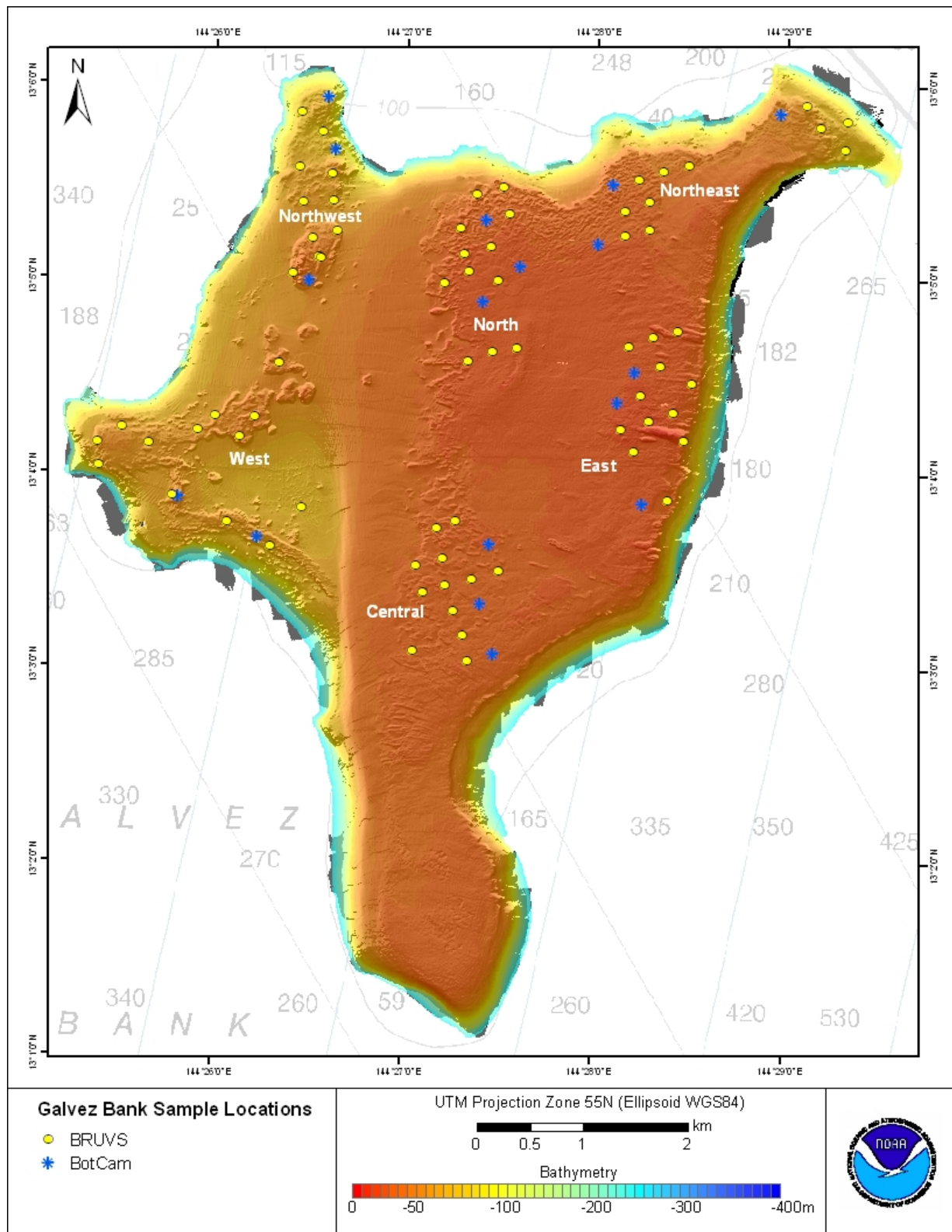
**Table B.3.1:--AUV transects at Galvez Bank.**

<b>AUV #</b>	<b>Deployment time, CHST (+ 10)</b>	<b>Deployment location</b>	<b>Surveyed distance</b>	<b>Notes</b>
1	14-Feb-10	13° 05.4'N 144° 26.5' E, Northwest Galvez Bank	n/a	Deployment aborted-caught under guy wire. Numerous points of damage.
2	15-Feb-10	13° 05.4' 144° 26.5' Northwest Galvez Bank	n/a	Deployment aborted-tag line jammed. Damage to strobe light on recovery.
3	15-Feb-10 12:30	13° 05.412' 144° 26.53' Northwest Galvez Bank Survey pattern: 6 leg sparse grid	810 m	Mission not completed. One hour drift down on site, drop weight released early, thrusters cycled on and off.
4	16-Feb-10 20:51	13° 05.39' 144° 26.56' Northwest Galvez Bank Survey pattern: 6 leg sparse grid	2,330 m	Long time to final drop while bridge repositioned. Mission not complete, drop weight released early on 5th long transect leg, thrusters cycled on and off.
5	17-Feb-10 21:48	13° 04.0 144°26.0 West Galvez Bank	n/a	Deployment aborted when AUV computer rebooted seconds after mission started, likely because of battery problems.
6	18-Feb-10 21:13	13° 04.70 144°26.20 West Galvez Bank Survey pattern: 6 leg sparse grid with long intermediate transit leg	2,690 m	A sparse grid with a dogleg / long transit to avoid a steep slope. Dive was successful, but was terminated early due to low batteries.
7	19-Feb-10 21:02	13° 05.43 144°27.40 North central Galvez Bank Survey pattern: 6 leg sparse grid	1,490 m	Mission was ended after completion of three long legs, as planned, to reduce battery charging time for daytime dive tomorrow.
8	20-Feb-10 14:13	13° 05.61 144°27.07 North central Galvez Bank Survey pattern: 6 leg sparse grid	1,570 m	Mission ended after over three tracklines, due to mission timeout being reached.

**Table B.3.2:--TOAD transects at Galvez Bank.**

<b>TOAD #</b>	<b>Deployment time, CHST (+ 10)</b>	<b>Deployment location</b>	<b>Surveyed distance</b>	<b>Notes</b>
GAL10001	2/14/2010 12:23 PM	13° 4.343' N 145 28.383' E East central Galvez	4.7 km	Medium relief and coral cover on east side; increasingly sandy moving westward.

## B.4. Baited Camera Stations



**Figure B.4.1.--Location of BRUVS and BotCam stations at Galvez Bank.**

Baited camera stations, including BotCam and BRUVS, were deployed at 6 sites at Galvez Bank from February 13, 2010 to February 20, 2010. Sites were limited to rugose, reef-like substrates delineated in ArcGIS using maps of multibeam bathymetry, backscatter and slope. Deployments were stratified within sites by depth zones ranging from 30 to 80 meters. A total of 17 BotCams, and 72 BRUVS were deployed with a grand total of 89 deployments.

**Table B.4.1.--Summary of Baited Camera Station deployments at Galvez Bank, listed by date and site.**

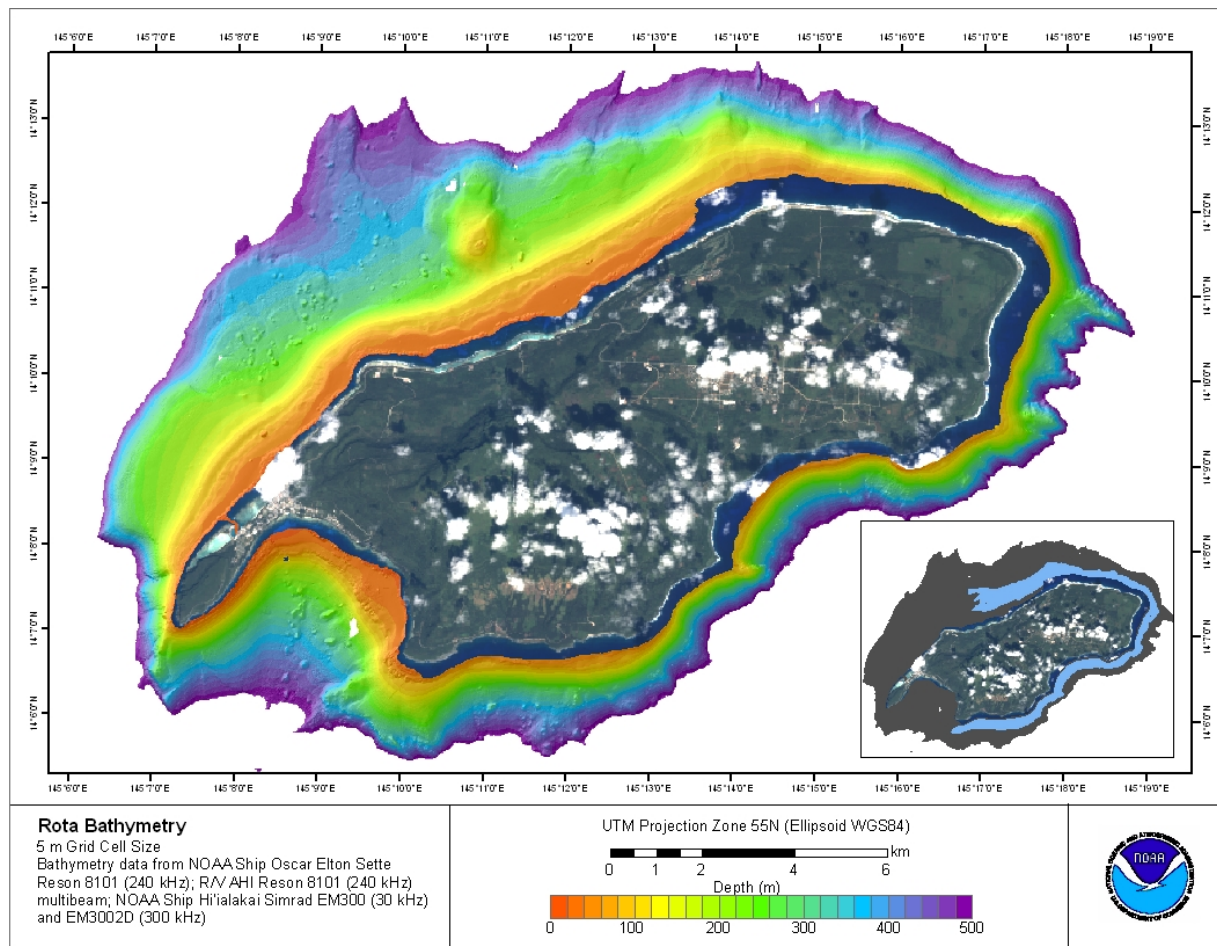
DATE	SITE	BotCam	BRUVS	TOTAL
2/13/2010	NW	1	4	5
2/16/2010	NW	2	7	9
	W	2	8	10
2/17/2010	N	3	12	15
	NE	1	4	4
2/18/2010	E	2	8	10
	NE	2	8	10
2/19/2010	C	3	12	15
	E	1	4	5
2/20/2010	W		5	5
Grand Total		17	71	89

**Table B.4.2.--Summary of Baited Camera Station deployments at Galvex Bank, listed by site and depth strata. NOTE: 1 BRUVS deployment was excluded from anyalsis as it did not land correctly, hence restricting the field of view.**

SITE	Depth Bin (m)					TOTAL
	30-40	40-50	50-60	60-70	70-80	
C	14					14
E	15					15
N	13	2				15
NE	6	4	2	1	2	15
NW		5	2	3	4	14
W		3	7	4	1	15
TOTAL	48	14	11	8	7	88

## Appendix C: Rota Results

### C.1. Multibeam Mapping



**Figure C.1.1.--Multibeam bathymetry collected at Rota. The inset figure shows data collected during SE-10-02 in light blue.**

**Table C.1.1.--CTD casts taken to develop sound velocity profiles for multibeam survey.**

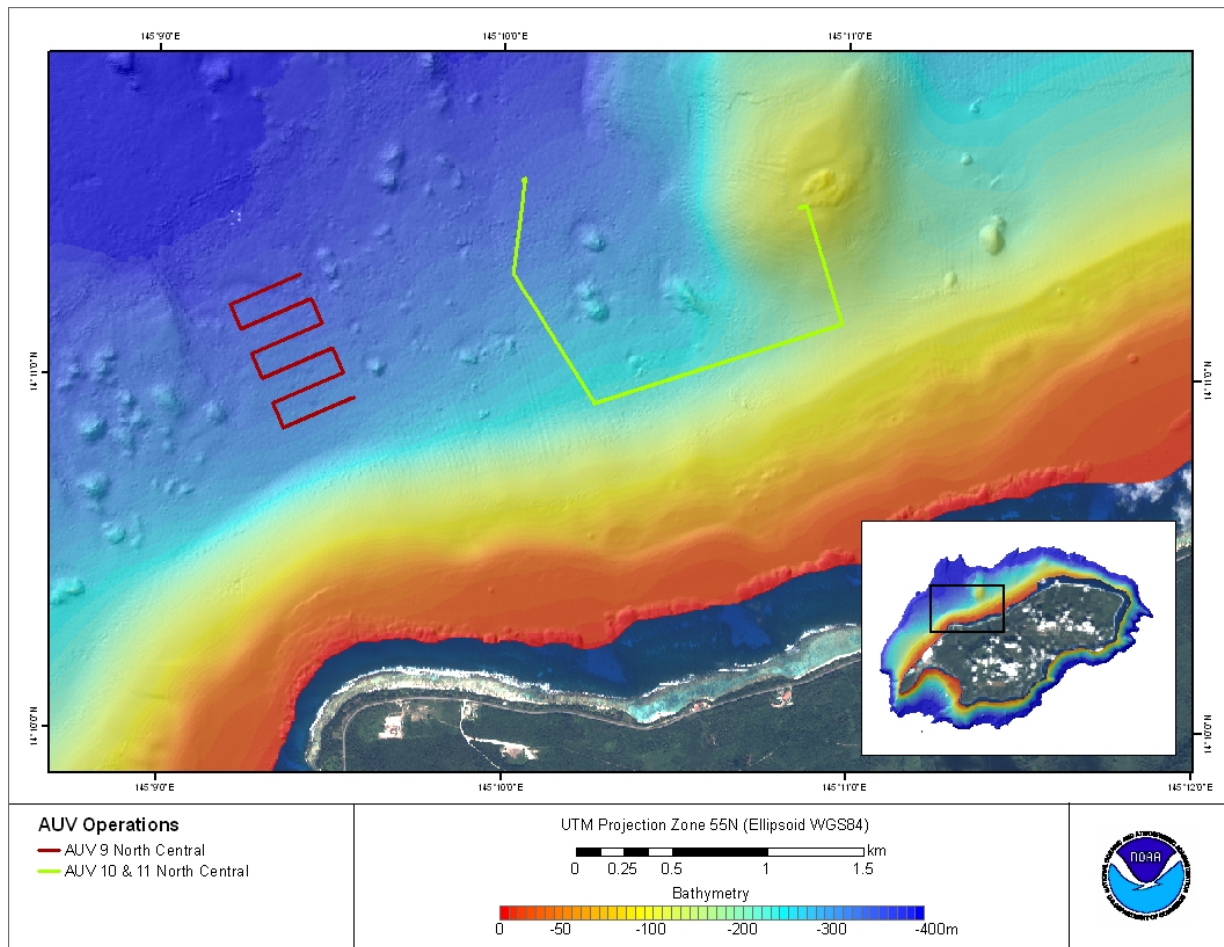
Date time	Cast name	Cast #	Position	Cast depth	Comments
052 0556	se1002_ctd10052_01	15	14 11.448N 145 08.655E	156	
053 0030	se1002_ctd10053_01	16	14 06.93 145 17.01	162	
054 0310	se1002_ctd10054_01a	17	14 08.536 145 15.946	162	
055 0851	se1002_ctd10055_01a	18	14 11.67 145 11.11	144	



## C.2. EK60 Fisheries Echosounder Transects

No EK60 transects were conducted at Rota.

## C.3. Underwater Vehicle Transects



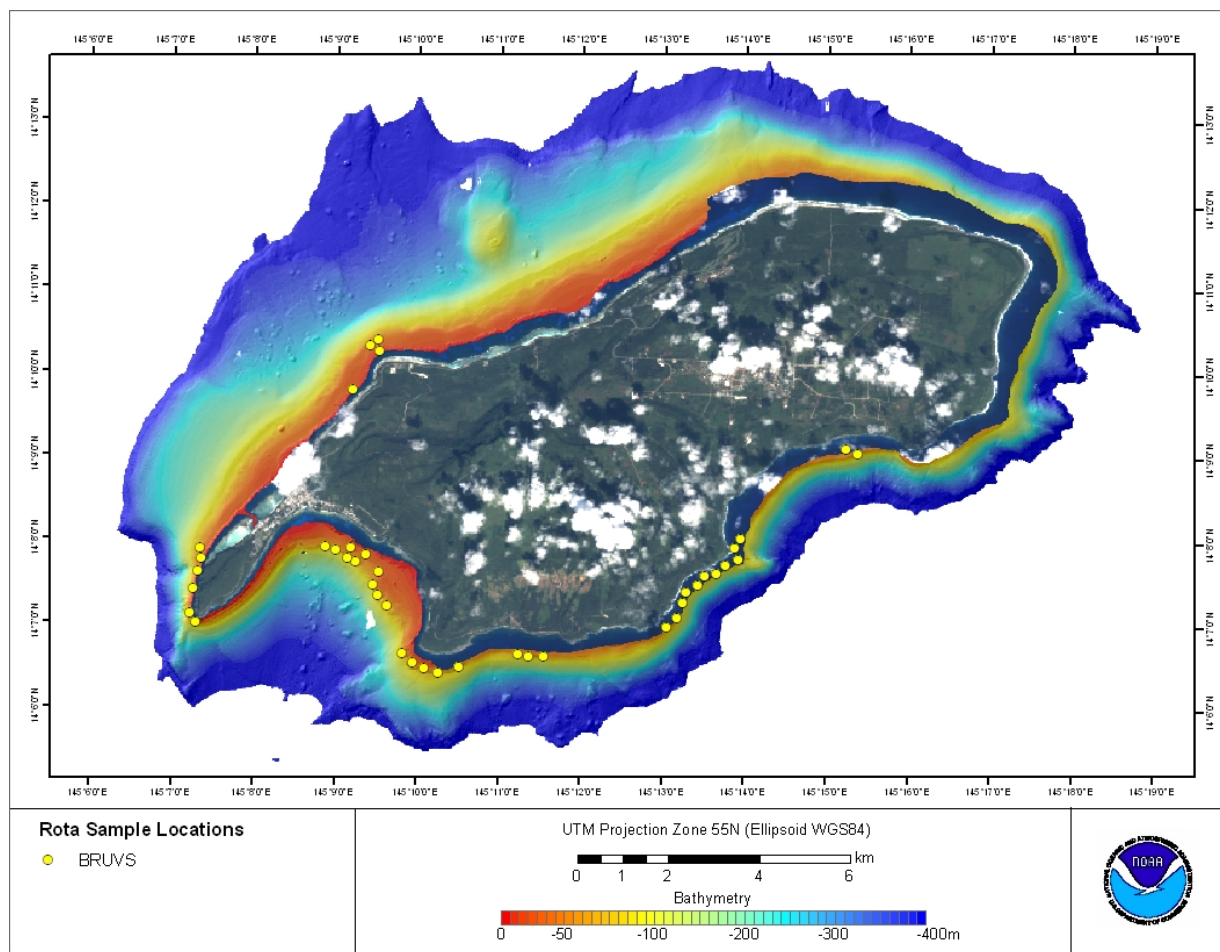
**Figure C.3.1.--Location of AUV and TOAD transects at Rota.**

**Table C.3.1--AUV transects at Rota.**

<b>AUV #</b>	<b>Deployment time, CHST (+ 10)</b>	<b>Deployment location</b>	<b>Surveyed distance</b>	<b>Notes</b>
9	21-Feb-10 20:17	14°10.94 145°9.57 North central Rota Survey pattern: 6 leg sparse grid	3120	Mission ran to route completion, establishing new depth (363 m) and time (4 hours) records for this group's AUV operations.
10	22-Feb-10 20:54	14°11.5 145°10.88 North central Rota Survey pattern: 4 leg ad hoc route	3450	Mission was a 4 leg haphazard route down-slope from ~ 100 m to 340 m, avoiding steep rock outcrops along the way. Mission ran to route completion but no photos were taken.
11	23-Feb-10 20:15	14°11.5 145°10.88 North central Rota Survey pattern: 4 leg ad hoc route	3450	Mission was a 4 leg haphazard route down-slope from ~ 100 m to 340 m, avoiding steep rock outcrops along the way. Mission ran to route completion. Downward photos only were taken. Some photos were telemetered to ship.



#### C.4. Baited Camera Stations



**Figure B.4.1.--Location of BRUVS stations at Galvez Bank. All deployments and recoveries at Rota were conducted using a small boat operating nearshore so the larger BotCams were not used at this location.**

**Table C.4.1.--Summary of Baited Camera Station deployments at Rota, listed by date and site.**

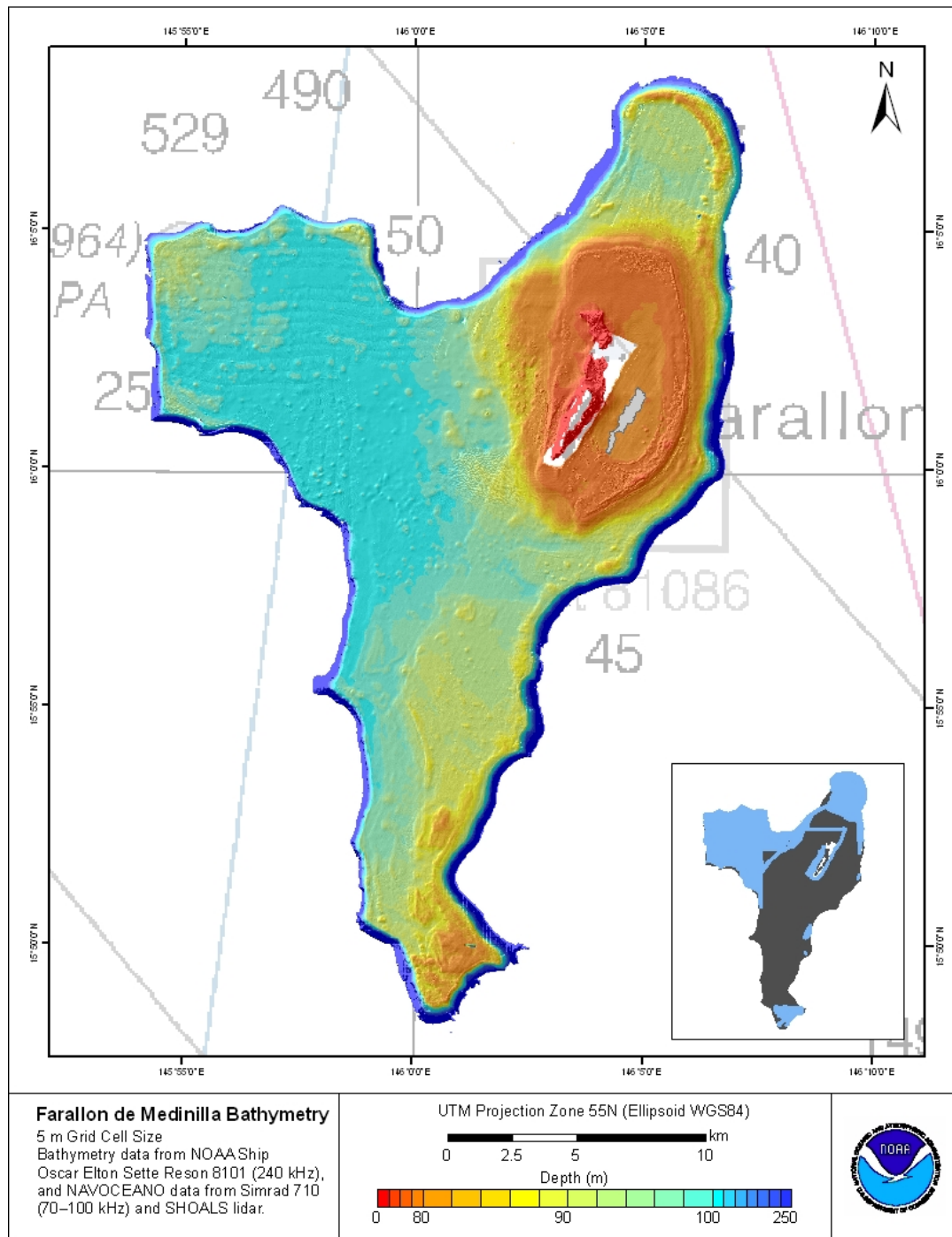
DATE	SITE	BRUVS	TOTAL
2/21/2010	W	8	8
2/22/2010	E	13	13
2/23/2010	SW	16	16
2/24/2010	W	8	14
	SW	6	
TOTAL		51	51

**Table C.4.2.--Summary of Baited Camera Station deployments at Rota, listed by site and depth strata. NOTE: 10 deployments were excluded from analysis as they did not land correctly and were restricting the field of view.**

SITE	Depth Bin (m)					TOTAL
	30-40	40-50	50-60	60-70	70-80	
W	5	4	3			12
E	2	3	5	1		11
SW	2	3	7	5	1	18
TOTAL	9	10	15	6	1	41

## Appendix D: Farallon de Medinilla Bank Results

### D.1. Bathymetry and Backscatter Imagery



**Figure D.1.1.--High-resolution bathymetry collected at Farallon de Medinilla. The inset shows collected bathymetry during SE-10-02 in light blue.**

**Table D.1.1.--CTD casts taken to develop sound velocity profiles for multibeam survey.**

<b>Day time</b>	<b>Cast name</b>	<b>Cast #</b>	<b>Position</b>	<b>Cast depth</b>	<b>Comments</b>
059 1425	se1002_ctd10059_01	19	15 58.001 145 57.518	126	FDM, west side
059 2225	se1002_ctd10059_02	20	16 08.415 146 04.919	160	FDM
060 0843	se1002_ctd10060_01	21	16 08.066 146 06.440	162	FDM, north side
060 1616	se1002_ctd10060_02	22	16 07.464 146 07.051	130	FDM, north side
061 0730	se1002_ctd10061_01	23	15 57.764 145 57.432	152	FDM, west side
061 1729	se1002_ctd10061_02	24	16 01.111 145 51.301	155	FDM, west side
062 0800	se1002_ctd10062_01	25	16 02.501 145 53.649	131	FDM, west side
062 1643	se1002_ctd10062_02	26	16 02.800 145 52.832	136	FDM, west side
063 0430	se1002_ctd10063_01	27	16 03.520 145 59.755	139	FDM, west side
063 1630	n/a	28, 29	16 04.806 145 53.522		Bad casts
063 1703	se1002_ctd10063_02	30	16 04.770 145 53.270	165	FDM, west side
064 0230	se1002_ctd10064_01	31	15 49.780 145 59.362	160	FDM, southwest side
064 1722	se1002_ctd10064_02	32	16 09.088 146 09.928	161	FDM, northeast side

## **D.2. EK60 Fisheries Echosounder Transects**

No EK60 transects were conducted at Farallon de Medinilla.

## **D.3. Underwater Vehicle Transects**

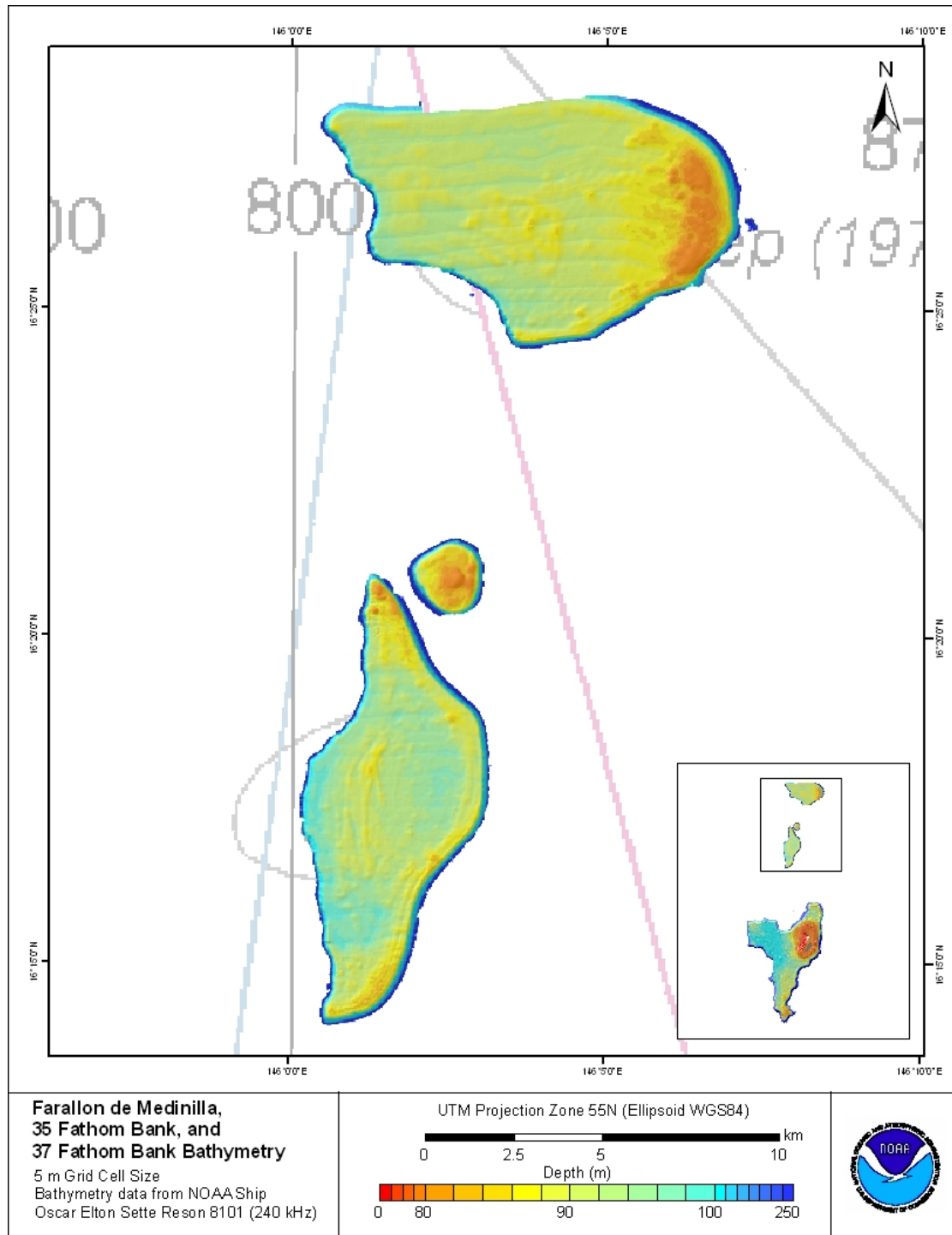
No baited camera stations were conducted at Farallon de Medinilla.

## **D.4. Baited Camera Stations**

No baited camera stations were conducted at Farallon de Medinilla.

## Appendix E: Northern Banks

### E.1. Multibeam Mapping



**Figure E.1.1.--High-resolution bathymetry collected at 37-fathom and 35-fathom banks north of Farallon de Medinilla.**

**Table E.1.1.--CTD casts taken to develop sound velocity profiles for multibeam survey.**

<b>Day time</b>	<b>Cast name</b>	<b>Cast #</b>	<b>Position</b>	<b>Cast depth</b>	<b>Comments</b>
065 0750	se1002_ctd10065_01	33	16 17.616 145 59.962	143	37-fathom bank
065 2331	se1002_ctd10065_02	34	16 25.219 146 05.916	135	35-fathom bank
066 1418	se1002_ctd10066_01	35	16 26.300 146 00.578	164	35-fathom bank

## **E.2. EK60 Fisheries Echosounder Transects**

No EK60 transects were conducted on the northern banks.

### E.3. Underwater Vehicle Transects

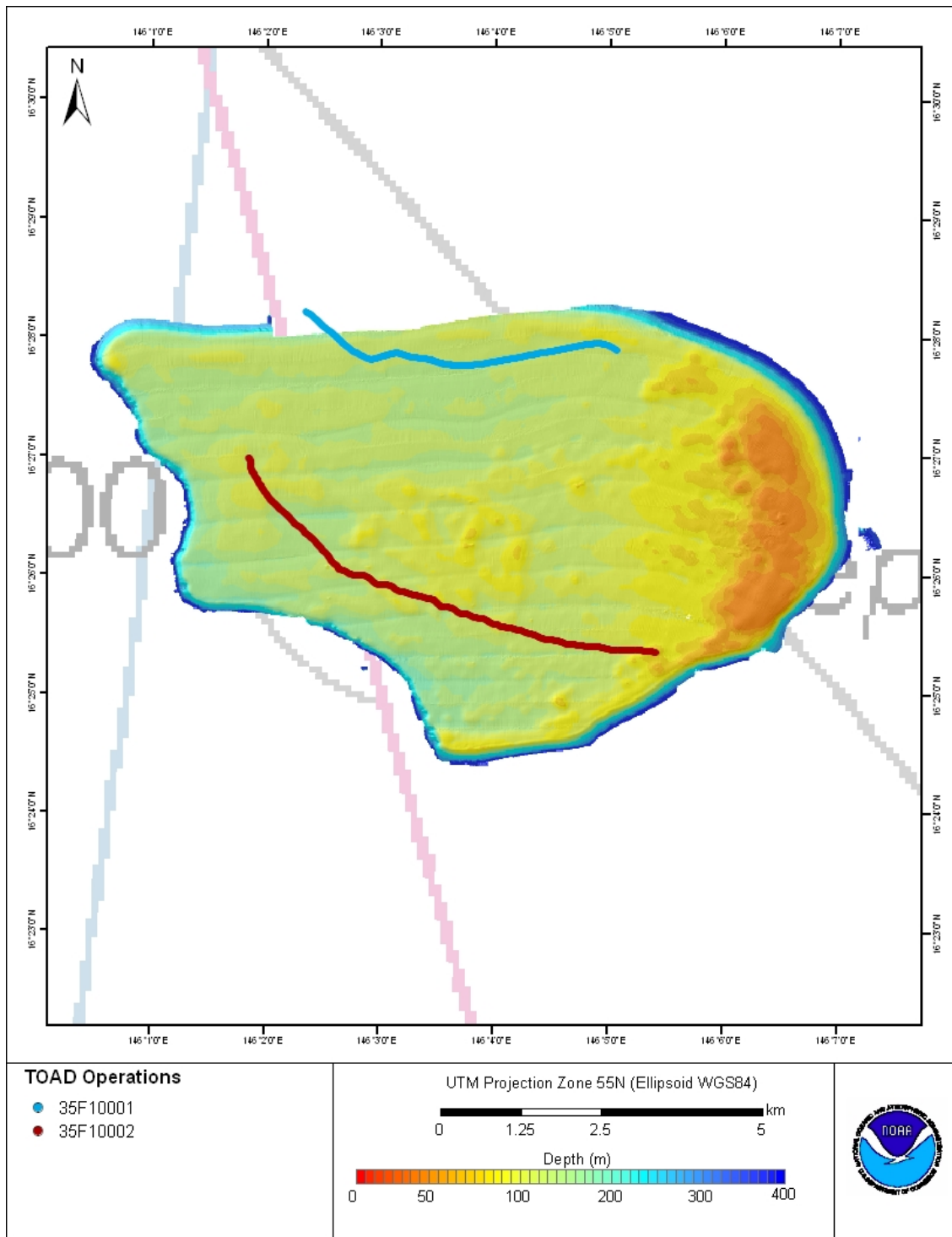


Figure E.3.1.--Location of TOAD transects at 35-fathom bank.

**Table E.3.1--TOAD transects at 35-fathom bank.**

<b>TOAD #</b>	<b>Deployment time, CHST (+ 10)</b>	<b>Deployment location</b>	<b>Surveyed distance</b>	<b>Notes</b>
35F10001	3/8/2010 10:40 AM	16° 27.932' N 146° 05.044' E Northeast 35-Fathom Bank	5.0 km	Mostly sandy, flat substrate with a few starfish, occasional macroalgae, holothurians, etc.
35F10002	3/8/2010 2:27 PM	16° 25.370' N 146° 05.439' E Southeast 35-Fathom Bank	7.3 km	Mostly sandy, flat substrate with rhotoliths at the SE edge and macroalgae and corals at shallower depths in center of bank.

#### **E.4. Baited Camera Stations**

No baited camera stations were conducted on the northern banks.



## Appendix F: Saipan Anchorage Results

### F.1. Multibeam Mapping

No additional multibeam mapping was conducted at the Saipan Anchorage. The area had been completely mapped during a previous cruise in 2003.

### F.2. EK60 Fisheries Echosounder Transects

No EK60 transects were conducted at the Saipan Anchorage..

### F.3. Underwater Vehicle Transects

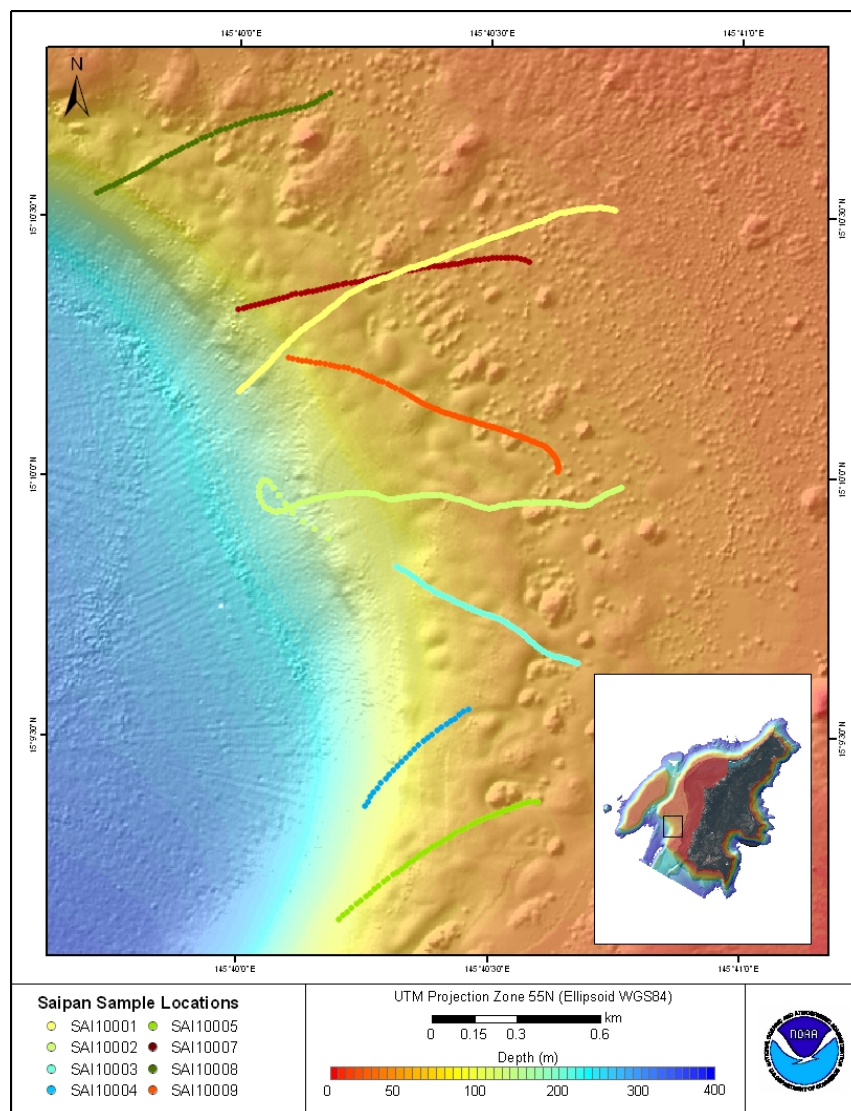


Figure F.3.1.--Location of TOAD transects at Saipan Anchorage.

**Table F.3.1.--TOAD transects at Saipan Anchorage.**

<b>TOAD #</b>	<b>Deployment time, CHST (+ 10)</b>	<b>Deployment location</b>	<b>Surveyed distance</b>	<b>Notes</b>
SAI100001	3/11/2010 7:33 PM	15° 10.521' N 140° 40.752' E, Southwest side Garapan Anchorage, nearshore bank	1.5 km	Mixed coral community inshore; Lots of plate corals offshore; sandy at seaward end of tow.
SAI100002	3/11/2010 9:52 PM	15° 09.984' N 140° 40.762' E, Southwest side Garapan Anchorage, nearshore bank	1.2 km	Mixed corals including thin branching one inshore; wide expanse of <i>Euphyllia paraancora</i> in middle, with algae.
SAI100003	3/11/2010 11:15 PM	15° 9.649' N 140° 40.674' E, Southwest side Garapan Anchorage, nearshore bank	0.8 km	Mixed corals including thin branching one inshore; wide expanse of <i>Euphyllia paraancora</i> in middle, with algae.
SAI100004	3/12/2010 7:59 PM	15° 09.830' N 140° 40.130' E, Southwest side Garapan Anchorage, nearshore bank	0.5 km	<i>Euphyllia paraancora</i> being overgrown by algae; many small fungid corals; sand and mixed algal community offshore.
SAI100005	3/12/2010 8:39 PM	15° 09.537' N 140° 40.603' E, Southwest side Garapan Anchorage, nearshore bank	0.9 km	Mixed coral community inshore; strip of sand; lots of <i>Euphyllia paraancora</i> and then sand again at seaward edge of bank.
SAI100006	3/12/2010 9:39 PM	NA	NA	Hypack software did not log track. We re-ran it with the next tow.
SAI100007	3/12/2010 10:56 PM	15° 10.423' N 140° 40.571' E, Southwest side Garapan Anchorage, nearshore bank	1.1 km	Dense reef patches interspersed with sand; a good amount of <i>Euphyllia paraancora</i> in the middle of the tow, and then sand again at seaward edge of bank.
SAI100008	3/12/2010 12:02 AM	15° 10.738' N 140° 40.183' E, Southwest side Garapan Anchorage, nearshore bank	0.9 km	Dense patches of mixed and plate coral reef interspersed with sand; less <i>Euphyllia paraancora</i> than in previous tows; sandy at both ends of tow.
SAI100009	3/12/2010 1:29 PM	15° 10.013' N 140° 40.636' E, Southwest side Garapan Anchorage, nearshore bank	1.1 km	Lots of well developed plate coral, extending below 90 m. Dense stands of <i>Euphyllia paraancora</i> in the middle of the tow.

#### F.4. Baited Camera Stations

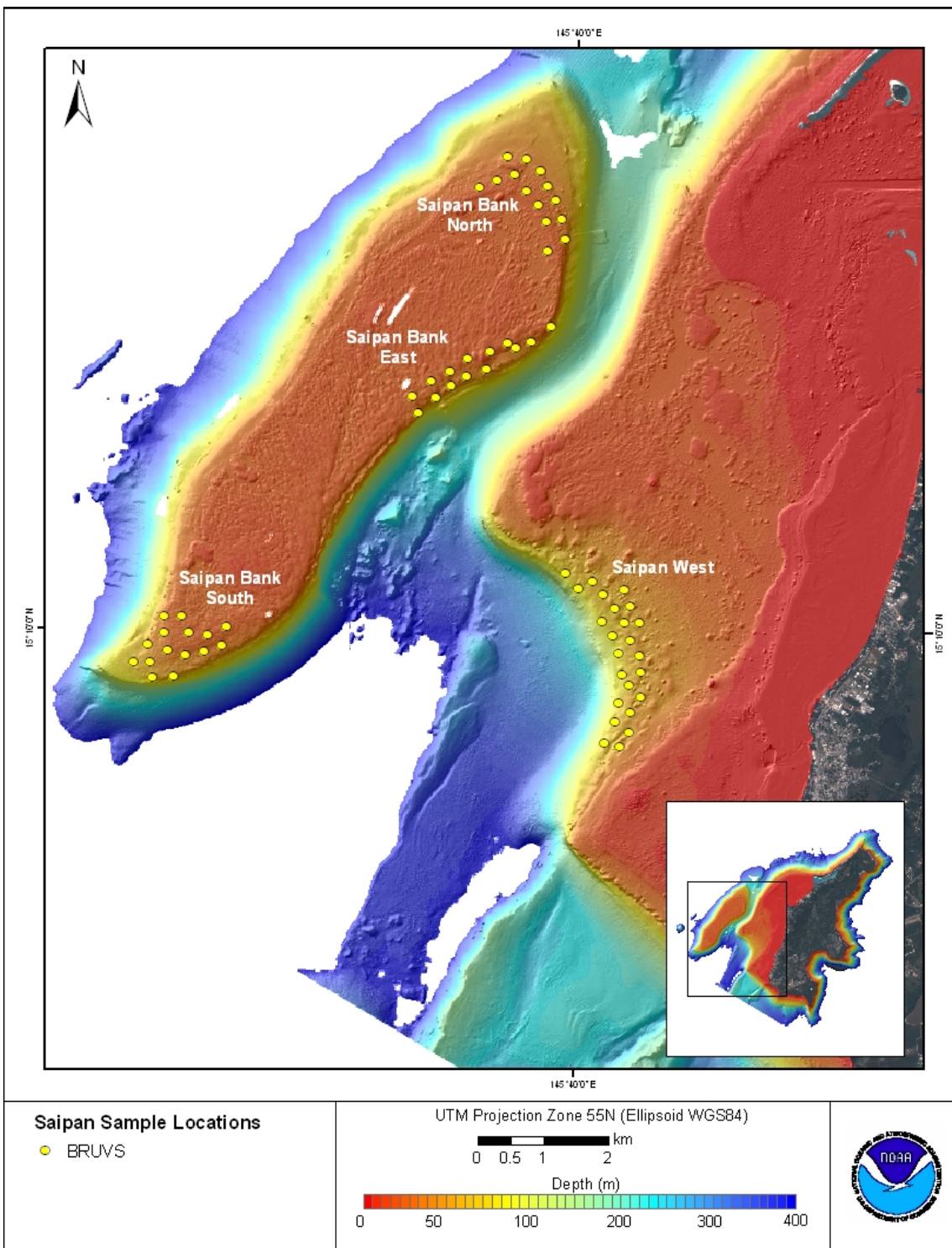


Figure F.4.1.--Location of BRUVS stations at Saipan Anchorage.

**Table F.4.1.--Summary of BRUVS baited camera station deployments at the Saipan Anchorage, listed by date and site.**

DATE		SITE	BRUVS	TOTAL
3/10/2010	Saipan Bank	N	8	8
3/11/2010	Saipan Bank	S	8	24
	Saipan Bank	E	8	
	Saipan Bank	N	8	
3/12/2010	Saipan Bank	E	8	24
	Saipan Bank	S	8	
	Saipan	W	8	
3/13/2010	Saipan	W	8	16
	Saipan	W	8	
TOTAL				72

**Table F.4.2.--Summary of BRUVS baited camera station deployments at Saipan Anchorage, listed by site and depth strata. NOTE: 5 deployments were excluded from analysis as they did not land correctly and were restricting the field of view.**

SITE		Depth Bin (m)						TOTAL
		30-40	40-50	50-60	60-70	70-80	80-90	
Saipan Bank	N	7	7					14
Saipan Bank	E	7	6	1				14
Saipan Bank	S	4	6		4	1		15
Saipan	W			7	7	2	8	24
TOTAL								67